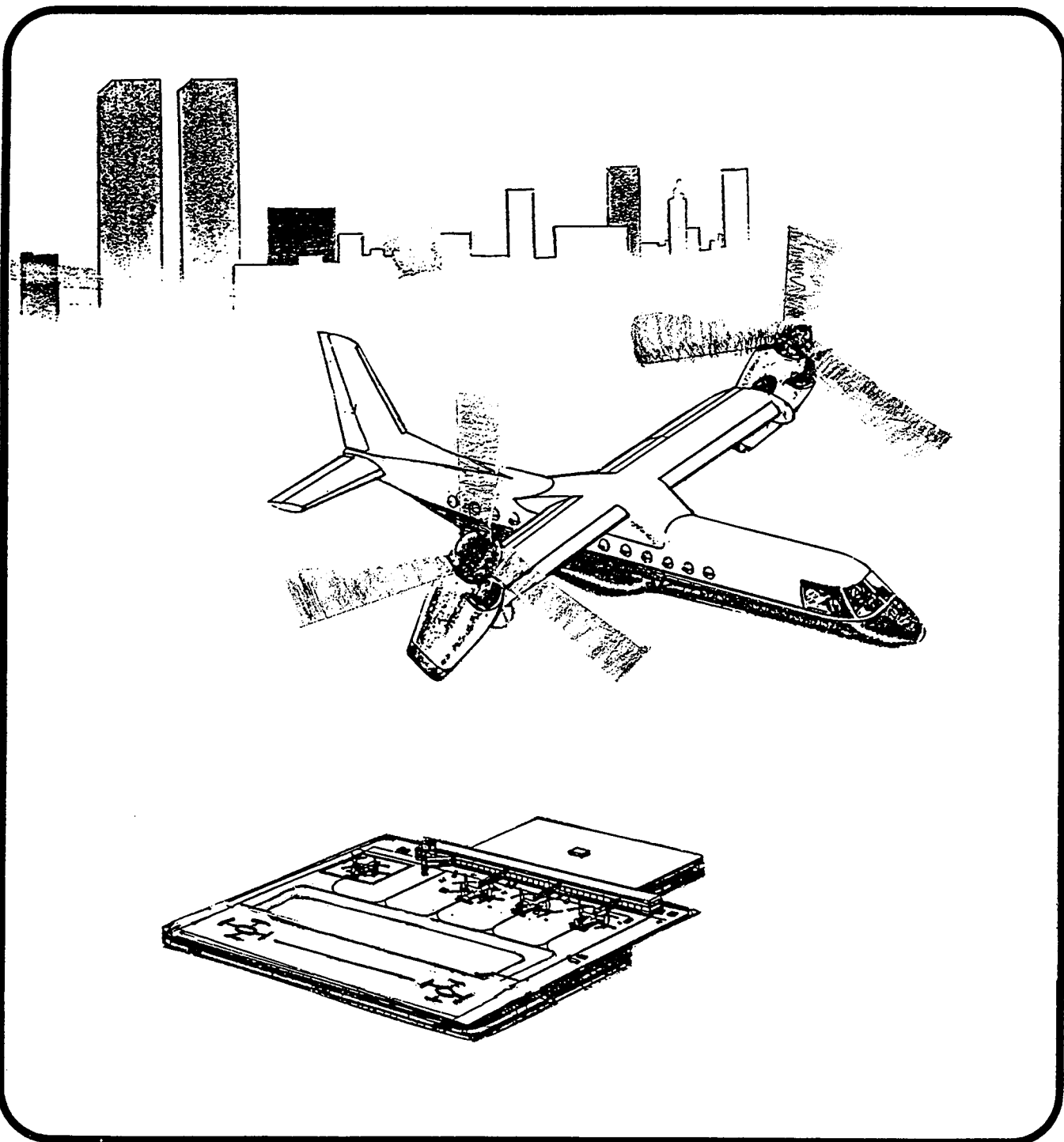


VERTIPORT DESIGN

Advisory Circular 150/5390-3

Date: May 31, 1991





U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: VERTIPORT DESIGN

Date: 5/31/91
Initiated by: AAS-100

AC No: 150/5390-3
Change:

1. PURPOSE. This advisory circular (AC) provides guidance to planners and communities interested in developing a civil vertiport or vertistop.

2. APPLICATION. The standards and recommendations contained in this AC are recommended by the FAA for use in the design of civil vertiports and vertistops. For vertiport projects receiving Federal grant-in-aid assistance, the use of these standards is mandatory. At certificated vertiports, the standards may be used to satisfy specific requirements of Federal Aviation Regulations (FAR), Part 139, Certification and Operations: Land Airports Serving Certain Air Carriers, Subpart D.

3. BACKGROUND. Tiltrotor technology offers a viable city-center to city-center air transportation capability and air transportation system capacity enhancement. The potential payback exceeds by a large margin that offered by any other technology presently identified or under development.

By eventually replacing many of the fixed-wing commuter aircraft, that utilize limited runway and airport assets, and accommodating their passengers with a tiltrotor aircraft landing and taking off from vertiports or vertistops, significant system capacity can be gained. Vertiports can be on airports, operating on a simultaneous but nonconflicting basis with fixed-wing traffic; urban-area vertiports located near city centers, negating the need for commuters with destinations in the urban area to even pass through the airport facilities; or smaller vertistops. Analyses conducted at three New York area airports show a replacement of only half of the commuter flights of 300 miles or less could result in a capacity gain of over 20 percent--with relatively little expenditure in additional construction when compared to the cost of new runways or airports.

With the objective of providing guidance for the construction of vertiports to meet system capacity and projected needs for civil tiltrotor operations, the FAA, with technical experts representing the industry, developed the design criteria in this AC.

Vertiport ability to support precision instrument operations with the lowest operating minimums is the objective of these design criteria. However, operating minimums are and will continue to be based on demonstrated aircraft, navigational aid, and pilot performance capabilities and limitations. The standards in this AC are based on the assumptions that manufacturers will develop a tiltrotor aircraft and navigational equipment with the demonstrated redundancy of performance to safely: (1) fly a 9-degree approach path during instrument meteorological conditions with an accuracy warranting reduced airspace, (2) decelerate to zero velocity prior to reaching the touchdown point, (3) transition from an instrument flight environment to visual environment before reaching the touchdown point, and (4) eliminate the necessity for missed approach areas and surfaces which differ from the areas and surfaces required for the approach.

A tiltrotor aircraft with navigational equipment and certified capabilities to operate safely and efficiently within the airspace recommended by this AC--with a sustained safety level commensurate with airplane operations--will have to be developed by industry to obtain the desired operating minimums.

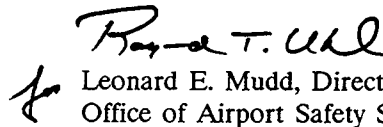

for Leonard E. Mudd, Director
Office of Airport Safety Standards

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APPENDIX 1

Tiltrotor aircraft (1 page)

APPENDIX 2

Vertiport marking (1 page)

CHAPTER 1. INTRODUCTION

1. GENERAL. This chapter explains terms unique to vertiports, provides general siting guidance, and identifies sources of technical information and guidance available to persons seeking assistance in the planning and design of a civil vertiport. The standards and recommendations in this advisory circular (AC) do not limit or regulate the operations of aircraft.

2. EXPLANATION OF TERMS. The FAA's Pilot/Controller Glossary in the Airman's Information Manual (AIM) explains common aviation terms. The following are additional terms unique to vertiports:

a. Vertiport. An identifiable ground or elevated area, including any buildings or facilities thereon, used for the takeoff and landing of tiltrotor aircraft and rotorcraft.

b. Vertistop. A vertiport intended solely for takeoff and landing of tiltrotor aircraft and rotorcraft to drop off or pick up passengers or cargo.

c. Vertical Flight Aircraft. Aircraft capable of vertical or near-vertical takeoffs and landings. Vertical-lift aircraft include:

(1) Rotorcraft--rotary-winged aircraft that lift vertically (to hover) and sustain forward flight by power-driven rotor blades turning on a vertical axis.

(2) Tiltrotor aircraft--rotorcraft with the axes of the power-driven proprotor blades capable of pivoting from vertical for vertical takeoff, landing, and hover operations to horizontal to derive lift from the wing in cruise.

(3) Tilt-wing aircraft--rotorcraft with both the wing chord and the axes of the power-driven proprotor blades capable of pivoting from vertical for vertical takeoff, landing, and hover operations to horizontal to derive lift from the wing in cruise.

(4) Fan-in-wing aircraft--fixed-wing aircraft with rotor fans in the wing to permit vertical or hover operations.

d. Rotor Span. The span (distance) between the extreme edges of the plane(s) generated by spinning rotors or proprotors.

e. Final Approach and Takeoff Area (FATO). A defined area over which the final phase of the approach maneuver to a hover or landing is completed and from which the takeoff maneuver is commenced. See Takeoff and Landing Area.

f. Touchdown and Lift-Off Surface (TLOF). The prepared (hard/paved) surface located within a FATO.

g. Takeoff and Landing Area. The defined area whose location, size, elevation, and alignment is used in FAR Part 77 to define the lower limits of the navigable airspace for the determination of obstructions to navigable airspace which are presumed to be hazards to air navigation until an FAA airspace study determines otherwise. Takeoff and Landing Area is the regulatory term for FATO.

3. SITE CONSIDERATIONS. Tiltrotor aircraft and other vertical-lift aircraft, in addition to their ability to serve cities located up to 400 miles (644 km) apart, can operate into population centers convenient to the user's origin and destination. Site selection should take advantage of these unique capabilities and provide convenient access to other modes of transportation or public transit.

a. Site Alternatives. Normally, vertiports or vertistops will be built at ground level. Near population centers, however, an elevated site may be more practical. Sites for elevated vertiports include: piers and docks; structures spanning interstate highways, city freeways, and railroad facilities; and the roofs of office buildings or parking garages.

b. Size. The FATO and TLOF should be sized to accommodate the largest vertical-lift aircraft forecasted to use the facility. A large FATO may have multiple TLOFs whenever two or more vertical flight aircraft are to be accommodated at one time. A better alternative, however, is to provide a separate parking apron or ramp.

c. Wind Flow Around Buildings. Guidance on locating facilities to compensate for the effect of buildings on the movement of air, i.e., turbulence, etc., is found in the FAA report "Evaluating Wind Flow Around Buildings on Heliport Placement," DOT/FAA/PM-84/25.

4. HELICOPTER USAGE. Although vertiports will support operations by both civil tiltrotor aircraft and civil helicopters, the design of certain vertiports where airspace is limited may make it impractical for older, less capable helicopters to operate at a particular vertiport. Design guidelines for all weather helicopter facilities (i.e., heliports and helistops with precision instrument approach capability) are contained in AC 150/5390-2.

5. FEDERAL (FAA) ROLE. The FAA has diverse roles in the planning, design, and development of a vertiport. These include: planning recommendations, publishing design criteria, reviewing aeronautical studies and environmental assessments, and financial assistance to eligible sponsors of public-use facilities.

a. Construction Notice.

(1) FAR Part 157, Notice of Construction, Alteration, Activation, and Deactivation of Airports, requires persons proposing to construct, activate, or deactivate a vertiport to give the FAA notice of their intent. Notice is also required when a vertiport is altered by a change in the number or size of the FATO's or the approach departure patterns. Figures 1-1 through 1-3 illustrate a Notice of Landing Area Proposal submission. For Item D2, Landing Area Data Layout, of FAA Form 7480-1, report the dimensions of the FATO as the dimensions of the Landing and Takeoff Area and the dimensions of the TLOF as the dimensions of the Touchdown Area.

(2) The FAA evaluates proposals to determine the impact upon:

(a) the safe and efficient use of the Nation's navigable airspace,

(b) the operation of existing or proposed air navigation facilities, and

(c) the effect upon the safety of persons and property on the ground. Proponents are notified of the results of the FAA evaluation.

b. Off-Site Construction Notice. FAR Part 77, Objects Affecting Navigable Airspace, requires persons proposing to erect or alter a structure to notify the FAA of any proposed construction or alteration which would be more than 200 feet (60 m) in height, and/or any proposed construction or alteration within a horizontal

distance of 5,000 feet (1 500 m) measured from the FATO edge of each vertiport available for public use that would penetrate an imaginary surface extending outward and upward from the FATO at a slope of 25 to 1. Public-use facilities are listed in the current issue of the Airport/Facility Directory. Figure 1-4 illustrates situations requiring notice.

c. Financial Assistance. The FAA-administered grant-in-aid program provides financial assistance to qualified proponents of vertiports. The grant covers a percentage of the costs incurred in planning and constructing a public-use facility. Information concerning the FAA grant program is obtainable from any FAA airports office. Addresses for FAA airports offices are found in AC 150/5000-3, Address List For Regional Airports and Airports District/Field Offices.

d. Environmental Assessments. The National Environmental Policy Act of 1969 and FAA's environmental review procedures require an environmental assessment be made prior to initiating actions concerning the Federal funding of vertiport development. These assessment actions usually accompany FAA approval of the proposed vertiport layout plan.

6. STATE AND LOCAL ROLES. Although in most cases, the proponents of public-use vertiports will be State or local authorities. Any proponent of a vertiport must coordinate the proposal(s) with State and local governmental agencies responsible for aviation, transportation, and land-use planning functions.


a. Notification. Some State and local governments require a favorable FAA "airspace determination" prior to issuing a permit or license to construct or operate a vertiport.

b. Assistance. State aviation authorities can provide technical advice comparable to that available from the FAA. Local planning and zoning offices should be contacted for guidance on matters of local building codes and land-use regulations affecting vertiport siting and development. Some States also have aid programs comparable to the FAA's.

7. OTHER SOURCES OF TECHNICAL ASSISTANCE. Consultants are available to provide technical advise on vertiport design and development. Tiltrotor, tiltwing, and rotorcraft operators and manufacturers can also provide valuable input to site selection and vertiport development studies.

8. MODIFICATION OF STANDARDS. Unique local conditions may justify modification of the vertiport design standards on a case-by-case basis. The request for modification must show that the modification will provide an acceptable level of safety, economy, durability, and workmanship. The dimensional values cited in paragraphs 11 and 12 are based on a projected civil tiltrotor aircraft with a 100-foot (30 m) rotor span. While no reduction in dimensional values is recommended for public-use vertiports, paragraph 11 and 12 dimensions may be proportionally reduced for private-use vertiports on the basis of the ratio of rotor spans when the facility will be used exclusively by smaller tiltrotor/tiltwing aircraft.

9. RESERVED.

 NOTICE OF LANDING AREA PROPOSAL									
U.S. Department of Transportation Federal Aviation Administration									
NAME OF PROPONENT, INDIVIDUAL OR ORGANIZATION Prince William County				<input checked="" type="checkbox"/> Establishment or Activation <input type="checkbox"/> Alteration <input type="checkbox"/> Deactivation or Abandonment <input type="checkbox"/> Change of Status		<input type="checkbox"/> Airport <input type="checkbox"/> Ultralight Flightpark <input type="checkbox"/> Heliport <input type="checkbox"/> Seaplane Base <input checked="" type="checkbox"/> Other (Specify) <u>Vertiport</u>			
ADDRESS (No., Street, City, State, Zip Code) County Administration Building									
A. Location of Landing Area									
1. NEAREST CITY OR TOWN		2. COUNTY		3. STATE		4. DISTANCE AND DIRECTION TO NEAREST CITY OR TOWN			
Woodbridge		Prince William		Virginia		Miles		Direction	
5. NAME OF LANDING AREA		6. LATITUDE		7. LONGITUDE		8. ELEVATION			
Prince William Vertiport		38° 39' 58"		77° 23' 36"		150' msl		1.3 ESE	
B. Purpose									
Type Use <input checked="" type="checkbox"/> Public <input type="checkbox"/> Private <input type="checkbox"/> Private Use of Public Lands		If Change of Status or Alteration, Describe Change.			<input type="checkbox"/> Establishment or change to traffic pattern (Describe on reverse)		Construction Dates To Begin/Begin Est. Completion 5/91 3/92		
C. Other Landing Areas									
		Ref. A5 Above		D. Landing Area Data		Existing (If any)		Proposed	
		Direction from Landing Area	Distance from Landing Area	1.	Magnetic Bearing of Runway(s) or Sealane(s)	Rwy #1	Rwy #2	Rwy #3	Rwy
Davison AAF		NE	6	1. Magnetic Bearing of Runway(s) or Sealane(s) Length of Runway(s) or Sealane(s) in Feet Width of Runway(s) or Sealane(s) in Feet Type of Runway Surface (Concrete, Asphalt, Turf, Etc.)					
National Airport		NE	15						
Washington Exed (Hyde)		NE	16						
Maryland		ESE	11						
MCAF Quantico		S	10	2. Dimensions of Landing and Takeoff Area in Feet Dimensions of Touchdown Area in Feet Magnetic Direction of Ingress/Egress Routes Type of Surface (Turf, rooftop, etc.)			250' x 250'		
Manassas (Davis Field)		WNW	12				100' x 100'		
Dulles International		NNW	19				02/20		
								Concrete	
E. Obstructions									
Type	Height Above Landing Area	Direction from Landing Area	Distance from Landing Area	3. Description of Lighting (If any)		Direction of Prevailing Wind			
Radio Tower	300'	SW	1	All HILS					
Elevated Water Tank	75'	E	1/4						
F. Operational Data									
1. Estimated or Actual Number Based Aircraft									
Airport, Flightpark, Seaplane base	Present (If est. indicate by letter "E")	Anticipated 5 Yrs. Hence	Heliport	Present (If est. indicate by letter "E")	Anticipated 5 Yrs. Hence				
Multi-Engine			Under 3500 lbs. MOW		0				
Single-Engine			Over 3500 lbs. MOW		0				
Glider					0				
2. Average Number Monthly Landings									
	Present (If est. indicate by letter "E")	Anticipated 5 Yrs. Hence		Present (If est. indicate by letter "E")	Anticipated 5 Yrs. Hence				
Jet			Helicopter	0	50 E				
Turboprop			Ultralight						
Prop			Glider						
3. Are IFR Operations Anticipated									
<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes Within _____ Years Type Navaid.									
H. Application for Airport Licensing									
<input checked="" type="checkbox"/> Has Been Made <input type="checkbox"/> Not Required <input type="checkbox"/> County <input type="checkbox"/> Will Be Made <input type="checkbox"/> State <input type="checkbox"/> Municipal Authority									
I. CERTIFICATION: I hereby certify that all of the above statements made by me are true and complete to the best of my knowledge.									
Name, title, (and address if different than above) of person filing this notice— type or print A. Nonymous County Administrator				Signature (In ink) <i>A. Nonymous</i> Date of Signature Jan. 10, 1991 Telephone No. (Precede with area code) 703-444-7777					

FAA Form 7480-1 (4-82) SUPERSEDES PREVIOUS EDITION

Figure 1-1. Example of vertiport construction notice

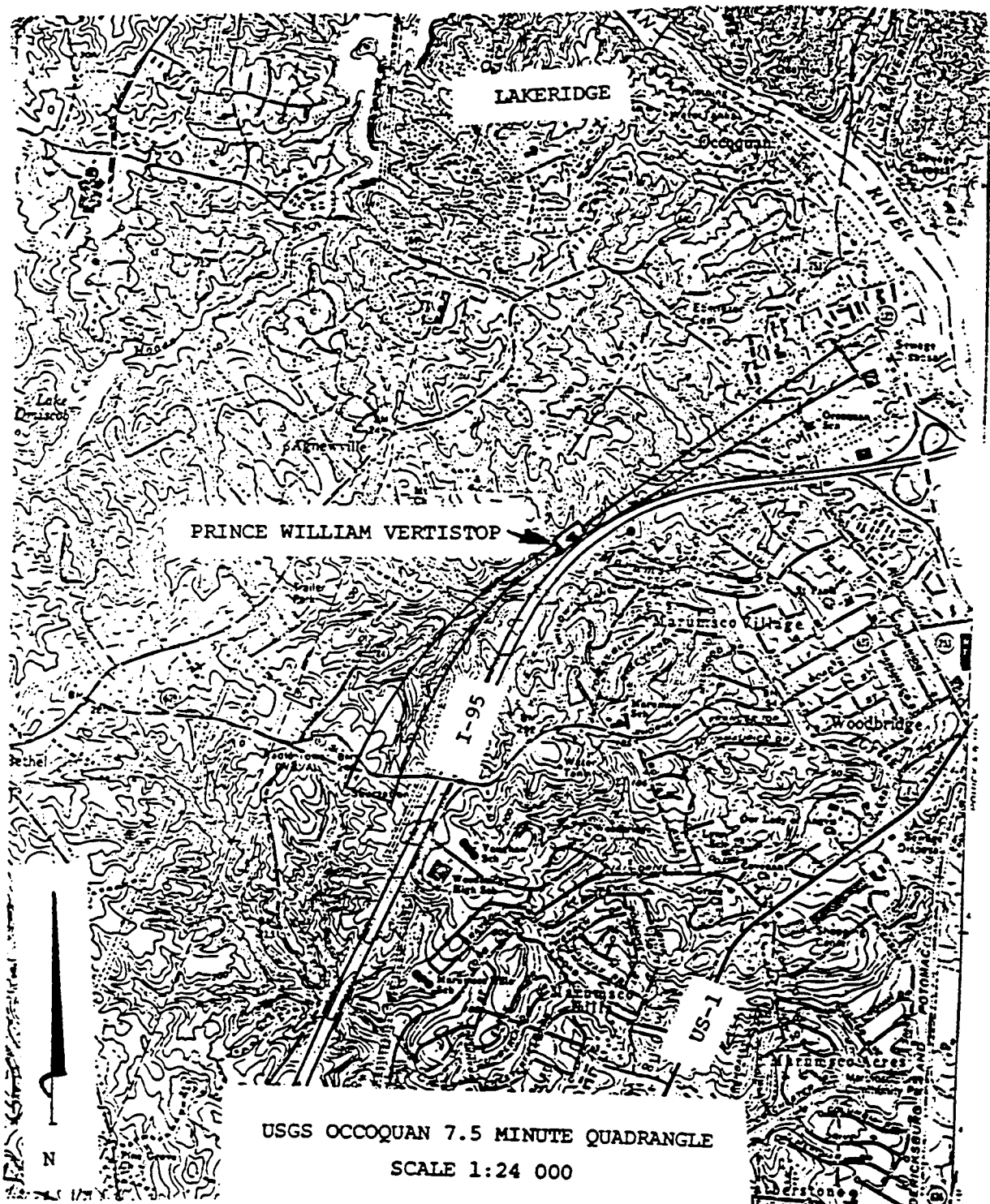


Figure 1-2. Example of a location map

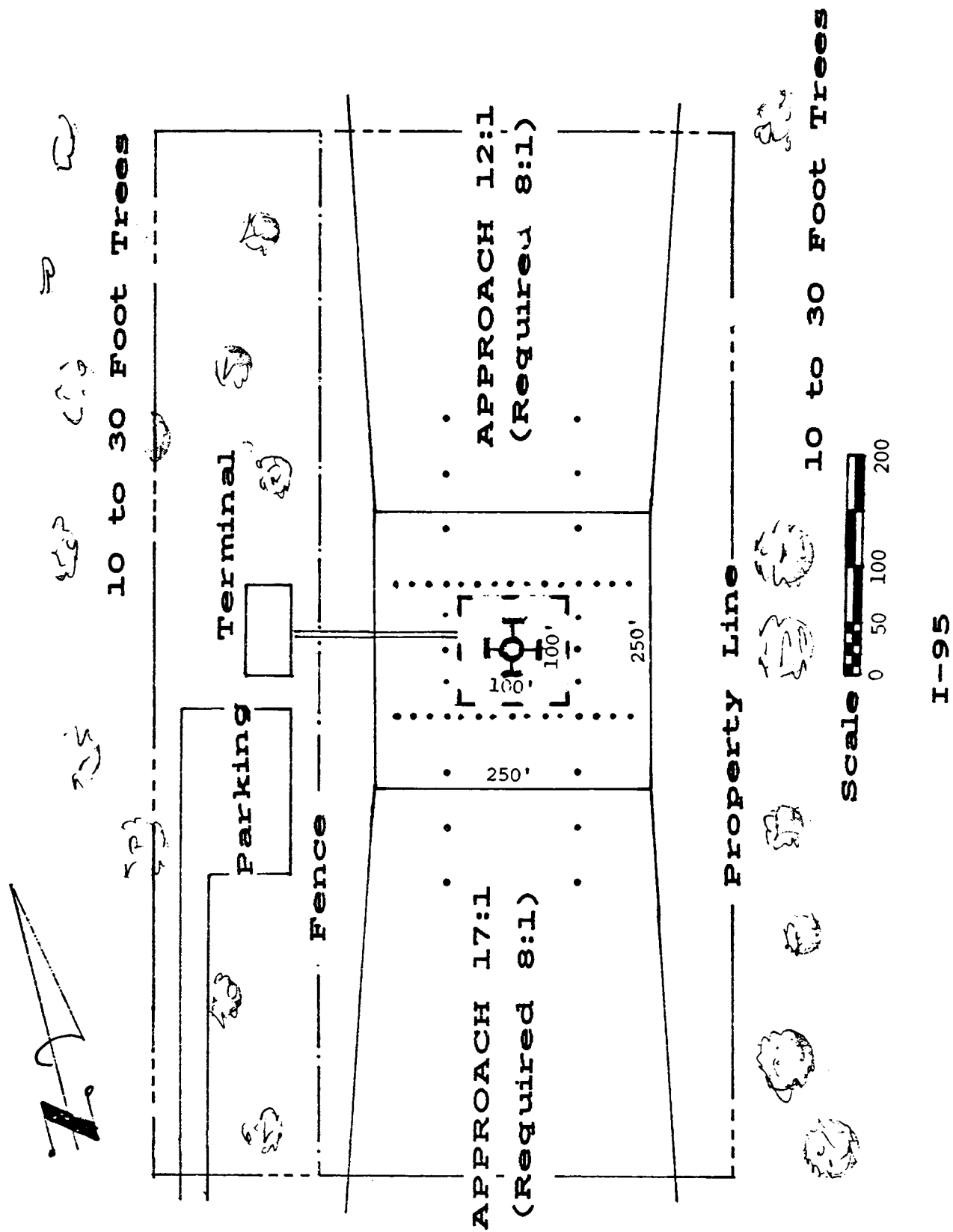


Figure 1-3. Example of a vertiport layout

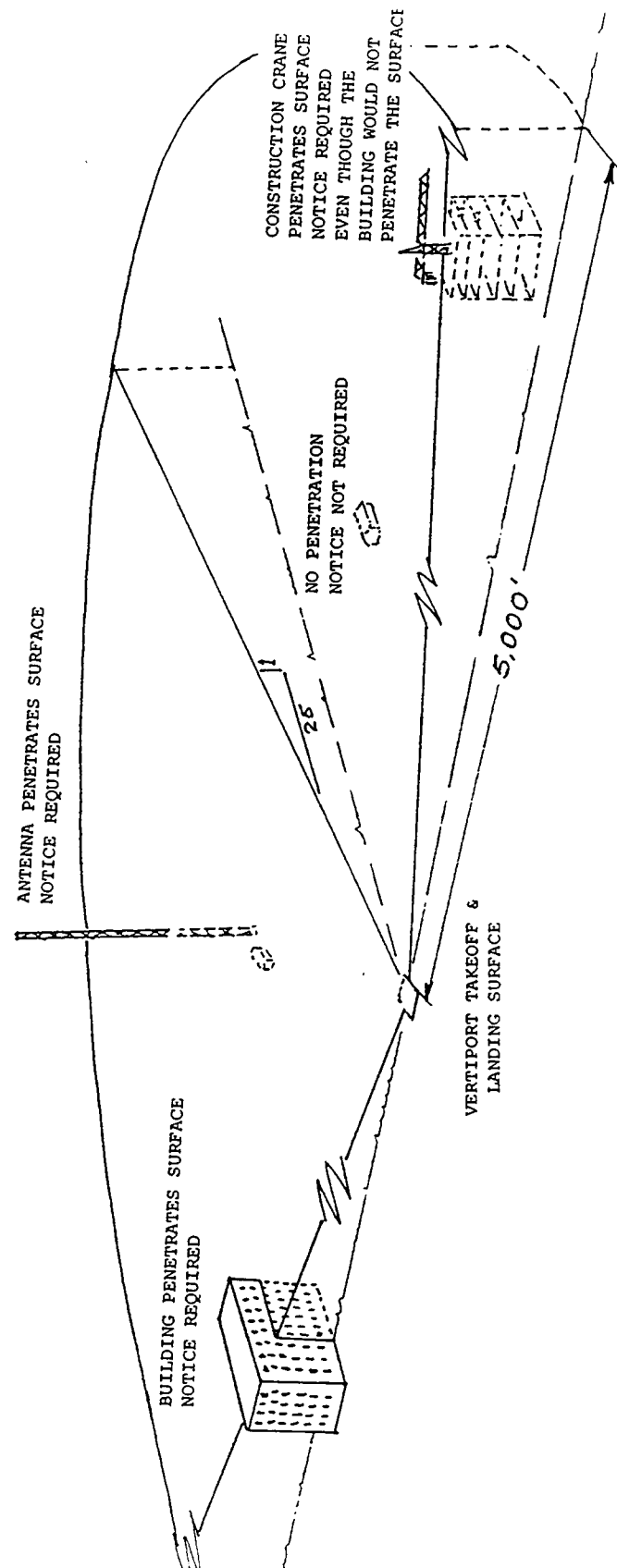


Figure 1-4. Example of notice requirements



CHAPTER 2. AIRSIDE DESIGN

10. GENERAL. This chapter contains airside design standards and recommendations for public-use vertiports and vertistops. For private-use vertiports or vertistops, these guidelines apply with the exception that private-use vertiports or vertistops require only an area for takeoffs and landings, i.e., a separate area for parking and loading may not be required and (a minimum of) one approach and departure path.

11. FINAL APPROACH AND TAKEOFF AREA (FATO). A vertiport or vertistop must have at least one FATO. The FATO may contain one or more touchdown and lift-off surfaces (TLOFs). For IFR operations, the FATO shall contain a TLOF.

a. Dimensions. While a FATO may have any shape, it must be capable of circumscribing a square with 250-foot (75 m) sides. A minimum size FATO is illustrated in Figure 2-1. To compensate for elevation at locations where the elevation of the FATO is in excess of 1,000 feet (300 m), the FATO length should be increased by 50 feet (15 m) per 1,000-foot (300 m) of elevation above MSL. When site conditions permit, larger FATOs are recommended.

b. Surface. The surface of the FATO shall be free of objects that would adversely affect the takeoff or landing of tiltrotor aircraft and be resistant to the effects of rotor downwash.

c. Alignment. The primary axis should be aligned to provide maximum wind coverage. Guidance on wind coverage is contained in AC 150/5300-13, Airport Design.

d. Clearing. FATOs shall be clear of objects except those whose locations are fixed by function. Objects fixed by function shall be located as far as possible from the TLOF and shall be frangible or mounted on low impact resistant supports.

e. Gradients. The slope in any direction in the unpaved portion of a FATO shall be between 1.5 and 5 percent. The maximum slope of paved portions of the FATO should not exceed 1 percent.

f. Elevated Vertiports and Vertistops. A full size load bearing FATO is recommended for elevated public-use facilities. Elevated private-use vertiports or vertistops may have portions of the FATO extend into unobstructed airspace beyond the edge of the building or platform.

12. TOUCHDOWN LIFT-OFF SURFACE (TLOF). The TLOF, normally located within a FATO, is a hard or paved surface capable of supporting the heaviest tiltrotor or other vertical-lift aircraft expected to use the facility.

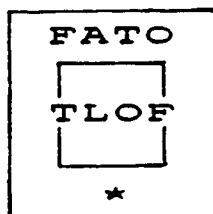
a. Dimensions. While a TLOF may have any shape, the minimum TLOF must be capable of circumscribing a square with 100-foot (30 m) sides for VFR and 150-foot (45 m) sides for IFR operations. An elongation of the TLOF [up to 400 feet (120 m)] offers significant operational and economic benefits and is recommended whenever site conditions permit.

b. Location. Normally, the TLOF is centered in the FATO with its primary axis centered on the final approach course. If not centered, there must be at least 75 feet (22.5 m) of clear space between the edges or ends of the TLOF and the edge of the FATO. For IFR operations, the TLOF must be located in the FATO with its primary axis centered on the final approach course. Figure 2-1 illustrates TLOF and FATO spatial relationships.

c. Gradients. Longitudinal and transverse gradients of a TLOF should not exceed 1 percent. Vertical curves should be used on elongated TLOFs to eliminate abrupt changes in grade. A rapid runoff shoulder, as illustrated in figure 2-2, is recommended adjacent to the paved surface. Vertiports with significant number of operations should have paved shoulders, 25 foot (7.5 m) wide, to minimize the effect of exhaust heat and propeller downwash on unpaved areas surrounding the TLOF.

d. Raised TLOFs. TLOF surfaces 4 feet (1.2 m) or more above the level of the FATO must have a 5 foot (1.5 m) wide horizontal safety net or shelf installed around the TLOF. The safety net or shelf, capable of supporting the weight of a person, should be at or below the surface of the TLOF.

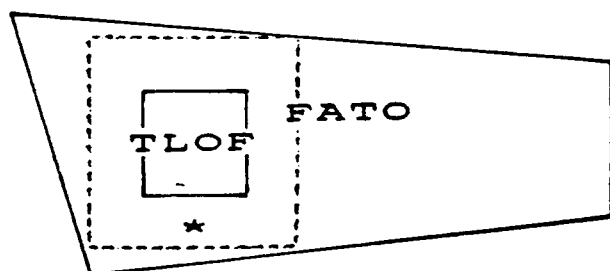
* Minimum 75' (22.5 m) Clearance



MINIMUM SIZE
FATO/TLOF



ELONGATED
FATO/TLOF



ODD SHAPED FATO
/MINIMUM TLOF

Figure 2-1. FATO and TLOF relationships

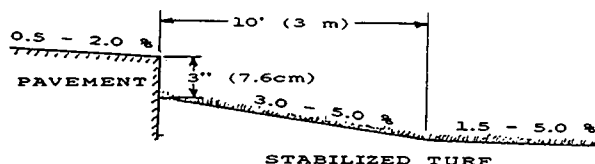


Figure 2-2. A rapid runoff shoulder

13. TAXIWAYS AND HOVER TAXIWAYS. A taxiway or hover taxiway connecting a TLOF to an apron or ramp used for passenger service, to a maintenance or storage hangar, to refueling locations, and to aircraft tiedown (parking) positions must be obstacle free. Figures 2-3 and 2-4 illustrate a taxiway and a hover taxiway.

a. Taxiway/Hover Taxiway Safety Areas. A ground taxiway requires a cleared safety area 150 feet (45 m) wide. The safety area for a hover taxiway is 250 feet (75 m) wide.



Figure 2-3. Hover taxiway safety area

b. Taxiways. Paved taxiways should be 75 feet (22.5 m) wide to assure that the engine exhaust is directed onto a heat and blast resistant surface. For economy, a taxiway may be constructed with a loadbearing center section equal to the aircraft's gear width plus 20 feet (6 m). The pavement, outboard of the loadbearing center section, must be capable of resisting the effects of the exhaust stream but may be of lesser structural strength.

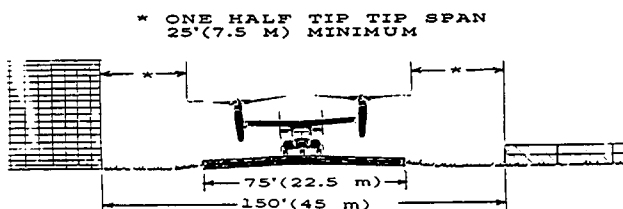


Figure 2-4. Vertiport taxiway

c. Clearances. At least one-half the tip-to-tip span, but not less than 25-feet (7.5 m), separation should be provided between the limit of the rotor span of an aircraft and a fixed or movable object with the aircraft's undercarriage 15 feet (4.5 m) from the edge of the taxiway. For hover taxiing, there should be 75 feet (22.5 m) of clearance between the limit of the rotor span of an aircraft on centerline and a fixed or moveable object.

d. Gradients. The gradients of paved taxiways (longitudinal and transverse) should not exceed 2 percent. Transverse grades of up to minus 3 percent are permitted in unpaved portions of a taxiway safety area.

e. Parallel Taxiways. The minimum distance between the centerline of an elongated TLOF and the centerline of a parallel taxiway, or between centerlines of parallel paved taxiways, is 200 feet (60 m).

14. APRONS AND RAMPS. Aprons or ramps for loading or unloading, parking, fueling, or servicing aircraft are sized to accommodate the number and type of aircraft which are expected to use the facility during peak activity periods.

a. Clearances. Aircraft parking positions should provide a minimum of one-half the tip-to-tip span, but not less than 25-feet (7.5 m), separation between the limits of rotor spans of adjacent aircraft, or between the limit of the rotor span of an aircraft and a fixed or moveable object. Figure 2-5 illustrates recommended apron and ramp clearances.

b. Gradients. Apron or ramp longitudinal and transverse gradients should be sufficient to assure positive runoff, but should not exceed 2 percent in any direction. Apron or ramp catchbasins should be located clear of passenger walkways.

c. Apron Edge Taxiways. The centerline of an apron or ramp edge taxiway should be located according to the guidelines in paragraph 13.

15. PAVEMENT DESIGN. The TLOF, taxiway, and apron or ramp must be designed to be capable of supporting the heaviest tiltrotor or other aircraft expected to use the facility. FAA AC 150/5320-6, Airport Pavement Design and Evaluation, provides technical guidance on pavement design. Designs must consider the following:

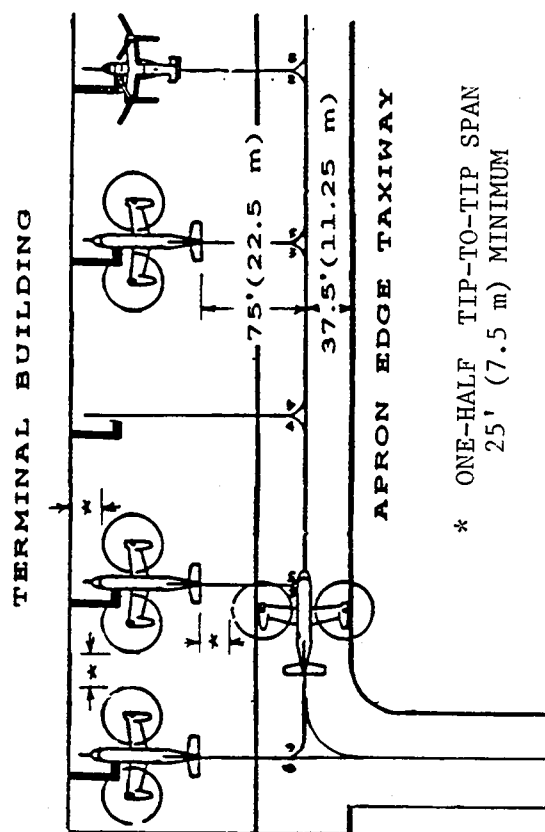


Figure 2-5. Vertiport apron or ramp

a. Static and Dynamic Loads. Assume dynamic loads imposed by the most critical aircraft expected to use the facility at 150 percent of the aircraft's static load (weight) with 75 percent of that load distributed equally through the aircraft's main landing gear. Appendix 1 provides information on tiltrotor aircraft proposed weights. AC 150/5390-2, Heliport Design, provides similar information for helicopters. Static loads imposed by service vehicles also need to be considered when designing elevated facilities.

b. Dust and Debris. Constructing light duty paved shoulders 25 to 35 feet (7.5 to 11 m) wide around all operational surfaces will help to alleviate dust and debris from being blown about by the downwash from propellers or rotors.

c. Engine Exhaust. Materials resistant to high temperatures should be used to minimize the effect of a tiltrotor's exhaust heat and velocity damaging or eroding the pavement or pavement joints.

16. WINTER OPERATIONS. Snow and ice removal is important for winter operations. Because of the strong downwash from landing or departing tiltrotor aircraft or rotorcraft, snow should be removed from the entire FATO, the taxiway safety area, and the apron or ramp area. The size of the area to be cleared of snow and ice and the frequency of snow fall will determine the method of control or removal used. At very small vertiports, in-pavement heating may be worthy of consideration. Plowing, deicing, and anti-icing may be more economical at larger vertiports. AC 150/5200-30, Airport Winter Safety and Operations, provides guidance on this subject.

17. FUELING. Fueling services may be carried out through a hydrant system located at parking positions, by trucks moving to the aircraft, or by aircraft moving to a centralized refueling location. If fuel trucks are used, the vertiport should be designed to minimize the need for them to operate on the FATO, TLOF, or taxiway system. Guidance for locating fueling areas to compensate for effects of buildings is found in "Evaluating Wind Flow Around Buildings on Heliport Placement," DOT/FAA/PM-84/25. If winds in the fueling area differ significantly from winds elsewhere on the vertiport, a wind indicator should be located in the fueling area. Hoses for hydrant systems or central fueling systems should be long enough to reach the largest aircraft expected at the vertiport while parked at the gate or fueling position.

a. Grounding Rods. Recessed grounding rods should be installed at all fueling locations.

b. Code Requirements. Fueling systems must comply with national and local codes and/or ordinances for flammable liquid storage and handling. Environmental considerations require that spilled fuel not contaminate water supplies or be discharged into sewer systems.

18. FIRE PROTECTION. Vertiports having scheduled passenger service meeting the conditions stipulated in Title 14, Code of Federal Regulations (14 CFR), Part 139, Certification and Operations: Land Airports Serving Certain Air Carriers, must comply with the fire protection requirements contained therein. Other vertiports and vertistops should apply the fire protection standards promulgated by the National Fire Protection Association (NFPA) and/or the fire protection requirements imposed by the local authority having jurisdiction.

19. SECURITY REQUIREMENTS. To ensure public and passenger safety, all operational areas of a vertiport must be secured to prevent unauthorized entry. The simplest system is a fence preventing access to vertiport operational, maintenance, and fuel storage areas. However, the fence should be located so that it does not become a hazard to flight operations. Legitimate access is through locked or manned gates. By their nature, elevated vertiports usually have simpler security requirements--their primary need being control of passenger movement. Refer to FAR Part 107, Airport Security, for requirements at vertiports having scheduled commercial service.

20. OTHER CONSIDERATIONS.

a. Vehicle Traffic. Mark traffic lanes used by fuel trucks and other support vehicles operating on the apron or ramp to prevent an incident or accident involving vehicles and moving or parked aircraft.

b. Aircraft Tiedowns. Tiedowns are recommended to secure parked aircraft to withstand the forces of unexpected winds. Tiedowns are particularly important for elevated facilities or vertiports or vertistops without hangars. Information on designing aircraft tiedowns is found in AC 20-35, Tiedown Sense.

c. Marking Wires. To assure aeronautical conspicuity, overhead wires in the vicinity of a vertiport should be marked with spherical markers except when an FAA aeronautical study finds that the absence of such markers will not impair aviation safety. Markers should identify overhead wires:

1) above a plane having a slope of 16 to 1 (horizontal to vertical) which rises from each edge of the FATO for a horizontal distance of 150 feet (45 m) from the FATO edge.

2) above a trapezoidal-shaped plane having a slope of 16 to 1 (horizontal to vertical) under the approach surface. The plane is 1,600 feet (480 m) long and extends 100 feet (30 m) outward beyond each edge of the approach surface.

21-29. RESERVED.

CHAPTER 3. AIRSPACE

30. GENERAL. This chapter contains airspace considerations for vertiports and vertistops. Imaginary surfaces associated with vertiport airspace are the primary surface, approach surfaces, and transitional surfaces. The size and configuration of these surfaces are dependent on location, size, elevation, and alignment of the takeoff and landing areas and the conditions under which operations are anticipated, i.e., visual operating rules (VFR) or instrument operating rules (IFR); and the type of approach associated with operations under those conditions, i.e., visual, nonprecision instrument, and precision instrument approaches. Precision approach surfaces are also highly dependent upon the angle of the approach, equipment of the aircraft, and proficiency and training of the air crews.

31. PRIMARY SURFACE. The primary surface is a horizontal plane having the size and shape of the FATO. It is at the elevation of the highest point on the TLOF(s). It abuts the inner edge of the approach surface, and for IFR, may extend beyond the FATO. The FATO is the same as the designated takeoff and landing area referenced in FAR Part 77.

32. APPROACH PATHS. Regardless of meteorological conditions under which operations are anticipated and the type of approach, public-use vertiports should have two or more object-free approach paths. Vertiport approach paths should be selected to maximize operations into prevailing winds and to minimize operations over noise sensitive areas.

SECTION 1. VFR

33. APPROACHES - VFR. The following surfaces, illustrated in figure 3-2, provide protection for visual approaches.

a. Approach Surfaces. The approach surface begins at the edge of the primary surface, where it has the same width as the primary surface, and extends outward and upward for a horizontal distance of 4,000 feet (1 200 m) where its width is 650 feet (195 m). The slope of the approach surface is 8:1 (horizontal to vertical).

b. Transitional Surfaces. Transitional surfaces extend outward and upward from the lateral boundaries of the primary surface and the approach surface. The planes slope upward at a ratio of 2:1 (horizontal to vertical) for a distance of 325 feet (98 m) measured horizontally from the centerline of the primary and approach surfaces.

c. Curved Approach Surface. While the outer portion of an approach surface may curve, the final 1,200 foot (360 m) segment abutting the primary surface is straight. Figure 3-1 illustrates a curved approach surface.

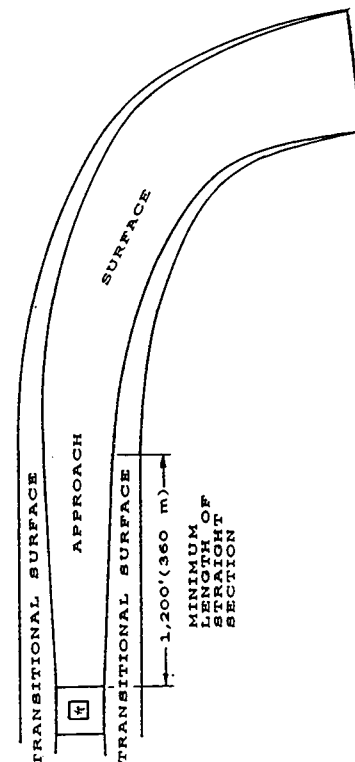


Figure 3-1. A curved approach surface

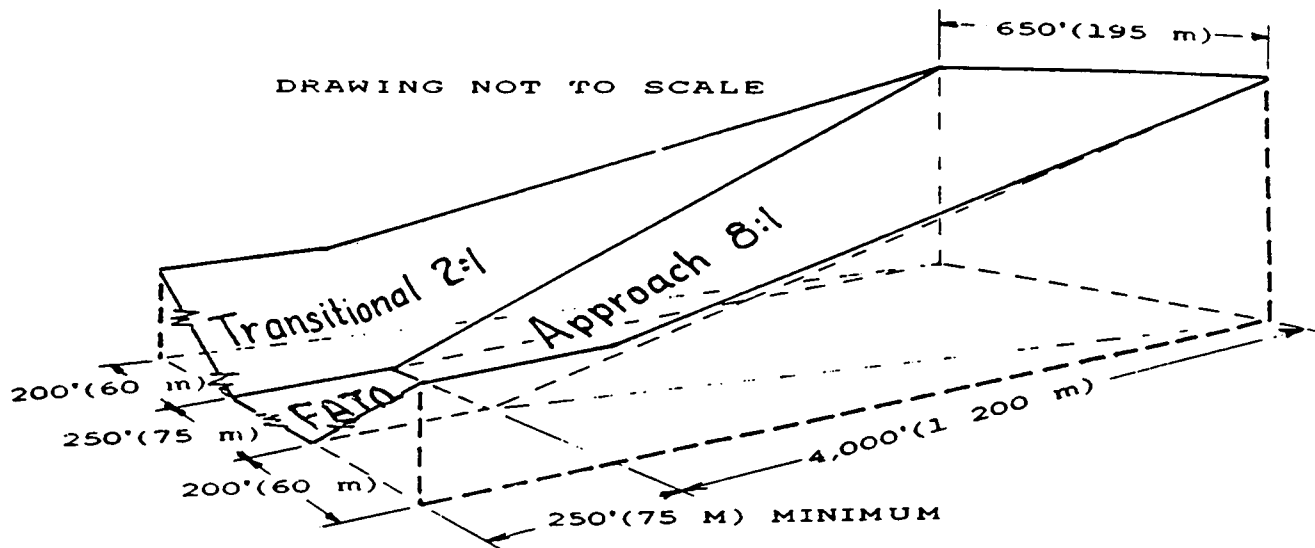


Figure 3-2. Vertiport visual approach surfaces

SECTION 2. IFR

34. APPROACHES - NONPRECISION INSTRUMENT. Most operations are VFR. Additional operations can be performed with a nonprecision instrument approach procedure to a point in space.

a. Procedures To a Point In Space. Nonprecision instrument operations can be conducted to a point in space. Weather permitting, a pilot may discontinue the instrument procedure and continue VFR to the vertiport. Under these conditions, the VFR surfaces defined in section 1 apply.

b. Procedures To The Vertiport. The following surfaces, illustrated in figure 3-3, provide protection for the visual segment of nonprecision instrument approaches to a vertiport. A vertiport's ability to support low landing minima is sometimes limited by obstructions in the missed approach segment.

(1) Approach Surface. The approach surface begins at the approach end of a primary surface of at least 300 feet (90 m) in length and width, where it has a width of 500 feet (150 m) and

extends outward and upward for a horizontal distance of 5,000 feet (1 500 m), where its width is 2,000 feet (600 m). The slope of the approach surface is 20:1 (horizontal to vertical).

(2) Transitional Surfaces. Transitional surfaces extend outward and upward from the lateral boundaries of the primary surface and the approach surface. The planes slope upward at a ratio of 4:1 (horizontal to vertical) for a distance of 350 feet (105 m) measured horizontally from the boundaries of the primary surface; and the distance varies along the boundaries of the approach surface from 350 feet (105 m) at the primary surface end and narrows to 0 feet at 2,000 feet (600 m) from the primary surface.

(3) Missed Approach Surfaces. The missed approach surface originates below the missed approach point and has a rising slope of 20:1. Any object penetrating the slope requires an adjustment of the minimum descent altitude. The dimensions of the missed approach area (including the radius of turn) vary with the type of missed approach. (Further guidance may be found in FAA Handbook 8260.3B.)

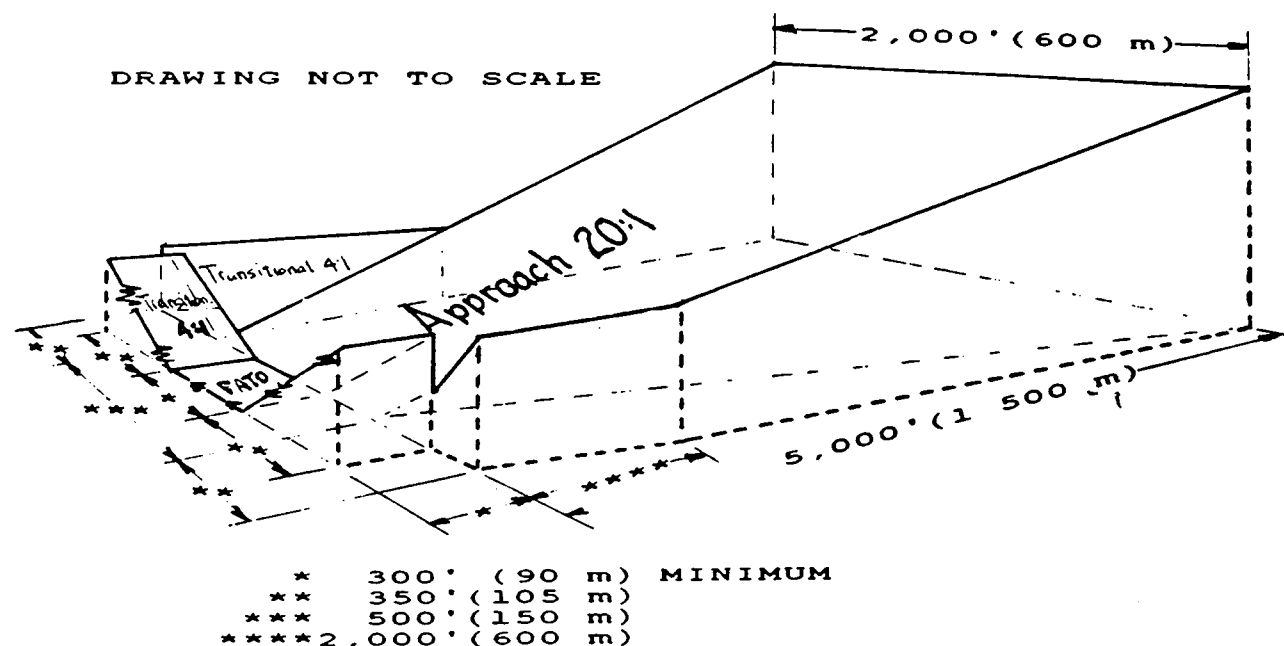


Figure 3-3. Vertiport nonprecision instrument approach surfaces

35. **APPROACHES - 6-DEGREE PRECISION INSTRUMENT.** The following surfaces apply to vertiports designed to accommodate 6- and/or 4-degree approaches for precision instrument operations. While most helicopters capable of precision instrument flight are certificated to fly 4-degree precision approaches, by modification and/or recertification, they may fly 6-degree approaches. The 6-degree approach surface is illustrated in figure 3-4.

a. **Approach Surface.** The approach surface is an imaginary trapezoidal-shaped plane. It begins 1,225 feet (373 m) from the back of the IFR FATO and extends outward for 25,000 feet (7 500 m) along the final approach course. It flares from a beginning width of 1,000 feet (300 m) to an ending width of 6,000 feet (1 800 m). The surface slopes upward at a ratio of 17:1 for a 6-degree glide slope and 25.5:1 for a 4-degree glide slope.

b. **Transitional Surfaces.** At 25,000 feet (7 500 m) from the 1,225-foot point, the surfaces are 1,500 feet (450 m) wide, measured from the outer edge at right angles to the final approach course, and

taper uniformly to a 600 foot (180 m) width at the 1,225-foot (373 m) point. The transitional surfaces rise at a slope of 7:1 (horizontal to vertical).

c. **Obstacle Free Zone (OFZ).** The OFZ consists of the IFR FATO (the approach OFZ) and the inner-transitional surfaces. The IFR FATO is 300 feet (90 m) wide by 1,225 feet (373 m) long. The inner-transitional surfaces extend out from the IFR FATO at a slope of 7:1 measured perpendicular to the IFR FATO for a distance of 350 feet (105 m).

d. **Missed Approach Surfaces.** A vertiport's ability to support low landing minima may be limited by obstructions in the missed approach segment. The missed approach surface originates 1,500 feet (450 m) beyond the decision point and rises at a slope of 20:1. Any object penetrating the slope requires an adjustment of the minimum descent altitude. The dimensions of the missed approach area (including the radius of turn) vary with the type of missed approach. Details of missed approach surfaces may be developed with an FAA procedures specialist.

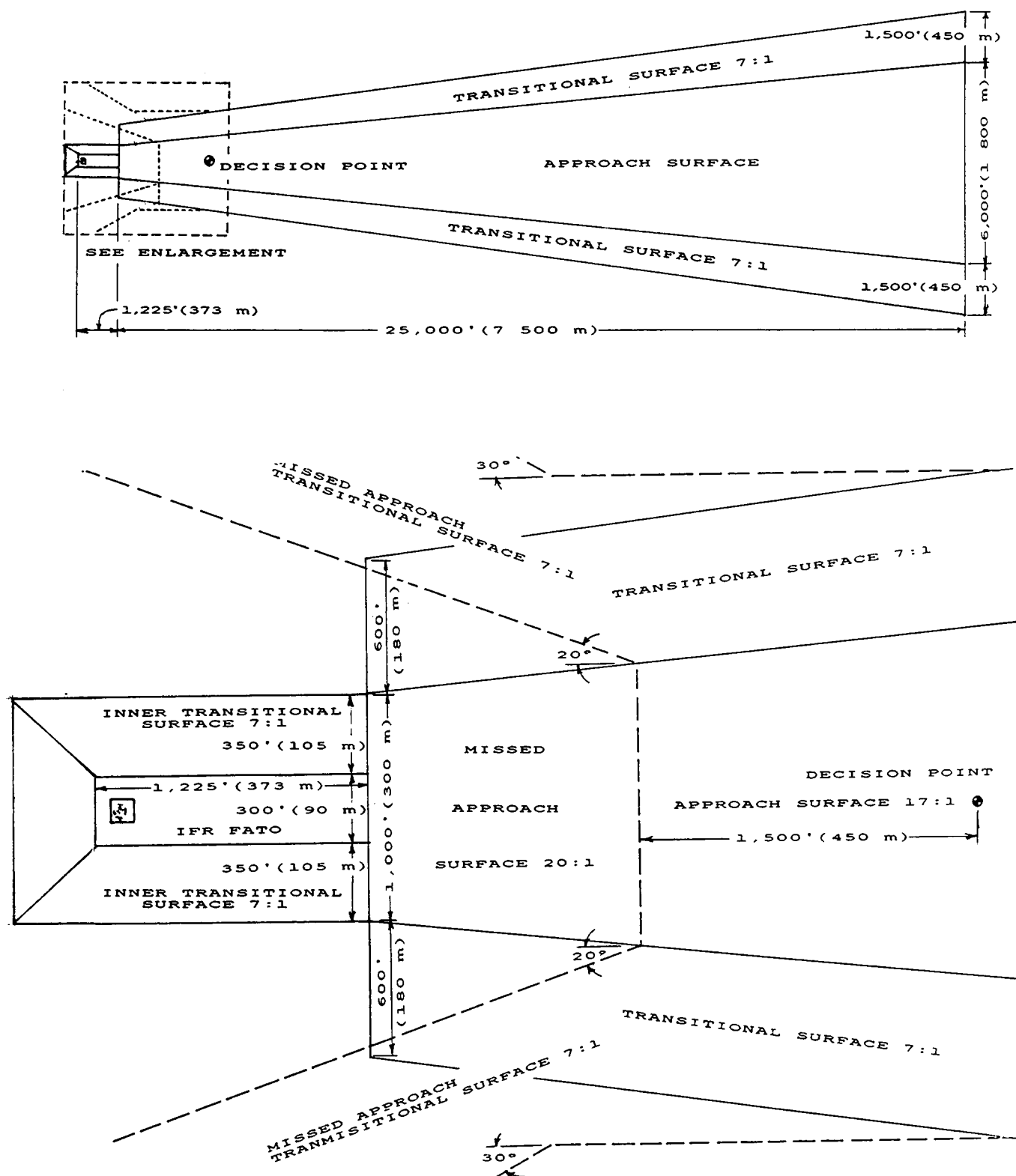


Figure 3-4. Vertiport 6-degree precision instrument approach surfaces

36. APPROACHES - 9-DEGREE PRECISION INSTRUMENT. The objective of these criteria is to design a vertiport with the ability to support precision instrument operations with the lowest possible operating minima. Operating minima are and will continue to be based on demonstrated aircraft, navigational aid, and pilot performance capabilities and limitations.

a. Assumptions. The standards in this paragraph are based on the assumptions that manufacturers will develop a tiltrotor aircraft and navigational equipment with the demonstrated redundancy of performance to safely:

- (1) fly a 9-degree approach path during instrument meteorological conditions with an accuracy warranting this reduced airspace,
- (2) decelerate to zero velocity prior to reaching touchdown point,
- (3) transition from an instrument flight environment to visual environment before reaching the touchdown point, and
- (4) eliminate the necessity for missed approach areas and surfaces which differ from the areas and surfaces required for the approach.

The dedicated approach area for these improved capabilities is illustrated in figure 3-5.

b. Approach Surface. The approach surface is an imaginary trapezoidal-shaped plane. It begins at the edge of, and at the width of the primary surface (250 feet (75 m) square), flaring to a width of 3,000 feet (900 m) in a horizontal distance of 10,000 feet (3 000 m). The trapezoid slopes upward at a ratio of 10:1 (horizontal to vertical).

c. Transitional Surfaces. Transitional surfaces slope outward and upward from the edges of the primary surface and the precision approach surface.

(1) The transitional surfaces adjacent to the primary surface slope upward and outward at a ratio of 3:1 (horizontal to vertical). These planes have a horizontal width of 600 feet (180 m).

(2) Transitional surfaces also rise from the edges of the precision approach trapezoid at a ratio of 7:1 (horizontal to vertical). These planes have a horizontal width of 600 feet (180 m) at the beginning of the approach trapezoid and flare to a horizontal width of 960 feet (293 m) at the outer end of the approach surface.

d. Missed Approach Surfaces. Missed approach surfaces are not prescribed since the missed approach must be flown within the approach airspace.

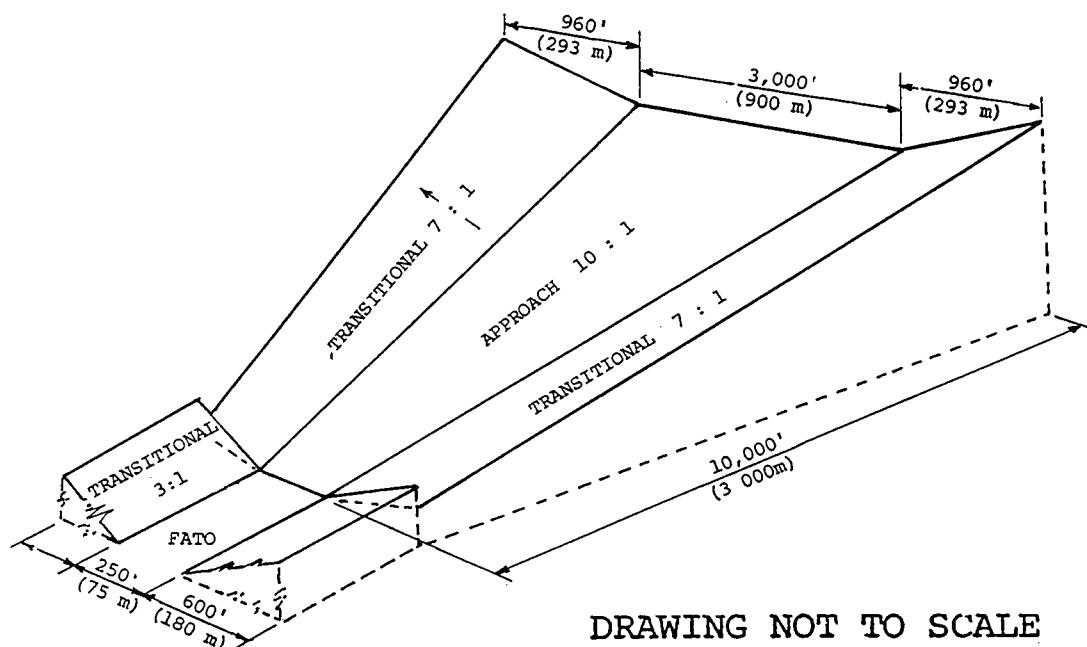


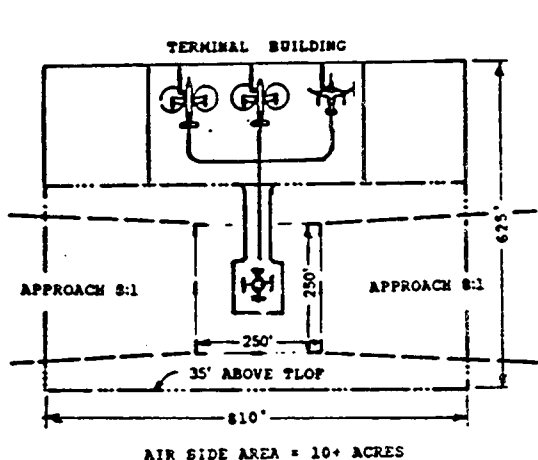
Figure 3-5. Vertiport 9-degree precision instrument approach surfaces

37. PROTECTION OF IMAGINARY SURFACES.

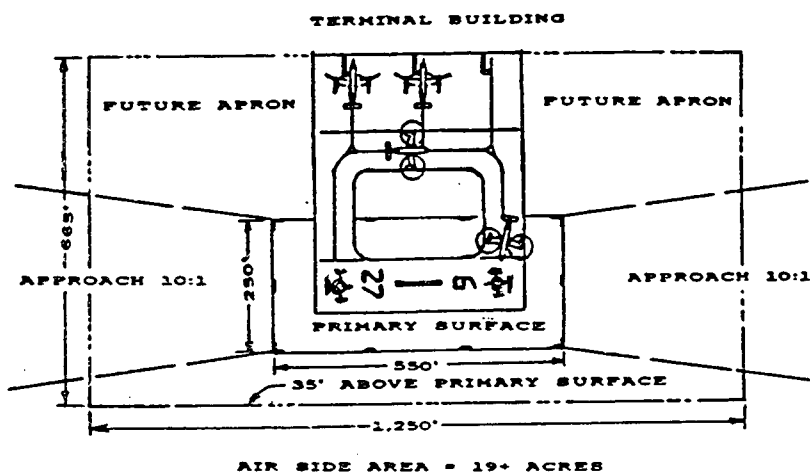
Vertiport proponents should own--or have control over--the surface under the approach, departure, and transitional surfaces out to the point where the imaginary surfaces are at least 35 feet (11 m) above the elevation of the highest point on the TLOF(s). Figure 3-6 illustrates the typical surface areas which should be owned or controlled to provide airside and close-in airspace protection for vertiports designed for VFR and IFR (with 6- and 9-degree approach angles) operations.

Vertiport designers and operators should maximize use of the available airspace over rivers, highways, railroads, etc. Ideally, the protected zones will be cleared of all objects not essential to flight operations. If clearing is impractical, acceptable use is limited to those activities which do not lead to the congregation of people. Protection through acquisition, supplemented by height and land-use zoning beyond the boundaries of the vertiport, is recommended.

38-39. RESERVED.

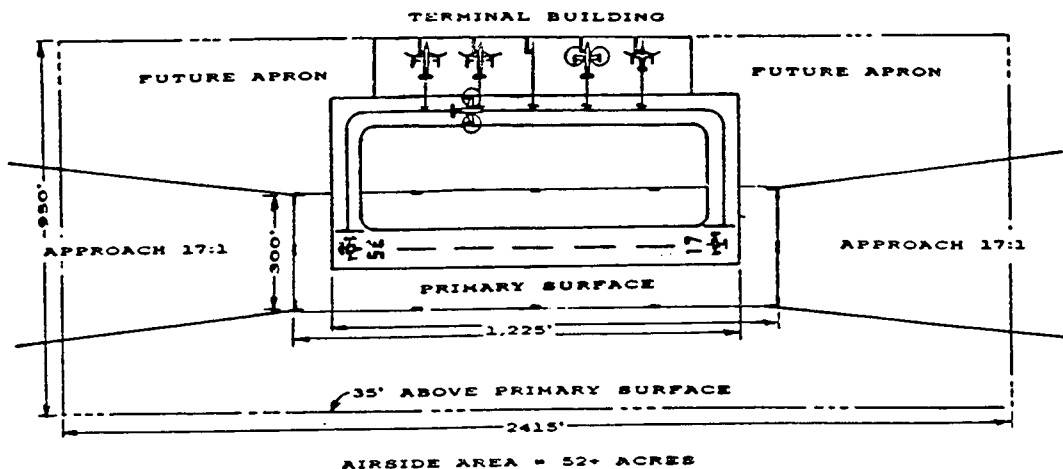


VFR VERTIPORT



IFR VERTIPORT

WITH 9° APPROACHES



IFR VERTIPORT WITH 6° APPROACHES

Figure 3-6. Typical vertiport airside and protected areas

CHAPTER 4. MARKING, LIGHTING, AND NAVAIDS

40. GENERAL. This chapter contains standards and recommendations for marking, lighting, and siting NAVAIDS on public-use vertiports and vertistops.

41. MARKING. Painted lines, numerals, and letters or raised boundary markers identify vertiport and vertistop surfaces. To increase conspicuity on light colored pavements, white markings should be edged with a 6 inch (15 cm) wide black line. Figures 4-1 and 4-2 illustrate marking recommendations.

a. FATO. The limits of the FATO should be defined with in-ground edge markers placed at the corners and at intervals of approximately 125 feet (37 m) along the FATO edges. Alternatively, raised markers, no more than 6 inches (15 cm) high, may be used in lieu of the recommended in-ground markers. Edges of a paved FATO are defined with 16 inch (40 cm) wide painted white lines.

b. TLOF. The edges of the TLOF are defined with a 16 inch (40 cm) wide painted white line not more than 1 foot (30 cm) in from the TLOF edge. When the length of the TLOF is more than three times its width, the TLOF has a centerline marked with 50 foot (15 m) long 16 inch (40 cm) wide painted white lines separated by 25 foot (7.5 m) spaces. The centerline begins 25 feet (7.5 m) from the numerals indicating the magnetic heading. Based on the elongated length, the length of the centerline stripes and spaces shall be reduced proportionally.

1) The distinctive marking shown in this AC is recommended for identifying a vertiport. Dimensions for the marking, suitable for a 100 foot (30 m) wide TLOF, are found in Appendix 2. The marking is centered on a square TLOF and is 20 feet (6 m) in from the end of an elongated TLOF. A one or two digit number, at least one-half the size of the symbol, reflecting the nearest 10 degrees of magnetic heading of the approach, identifies the ends of an elongated TLOF.

2) On a vertiport or vertistop, where the maximum aircraft weight and rotor span is restricted, the restriction is indicated in the near right corner of the TLOF. See figure 7-5. The number above a bar indicates the maximum aircraft weight in thousands of pounds. The number below the bar indicates the maximum rotor span in tens of feet.

c. Taxiways. All taxiway markings are yellow. Taxiway centerlines are marked with a 6 inch (15 cm) wide line. Taxiway edges are marked with double 6 inches (15 cm) wide lines spaced 6 inches (15 cm) apart. That portion of taxiway pavement that is not full strength is marked with yellow 3 foot (1 m) wide bars perpendicular to the taxiway centerline at intervals not in excess of 30 feet (9 m).

d. Hover Taxi Routes. Cylindrical raised markers are used to define the outer edges of the hover taxi route safety area. Markers should be 3 feet (1 m) in height, be retroreflective, and provide maximum color contrast with the natural background.

e. Aprons and Ramps. Six inch (15 cm) wide yellow lines may be used to guide aircraft into each intended parking position. Parking positions (gates) may be identified by a letter or number.

f. Passenger Walkways. An enclosed boarding ramp is recommended for the safety, comfort, and convenience of passengers. In the absence of a boarding ramp, a 5 foot (1.5 m) wide walkway should be painted to define a safe path between parked aircraft and the terminal building or exit gate.

42. LIGHTING. Vertiports are lighted with standard aviation lighting fixtures. Shielded floodlights may be used to illuminate passenger boarding positions on the apron. Figures 4-1 through 4-3 illustrate vertiport lighting.

a. FATO. The limits of a ground level FATO need not be lighted if the TLOF is lighted. On elevated vertiports or vertistops, an odd number of L-810 red double lens obstruction lighting fixtures are used to mark the edges of the building. FATO or building edge lights should be spaced approximately 50 feet (15 m) apart.

b. TLOF. An odd number, but not less than five L-861 yellow omni-directional lights located at least 10 feet (3 m) out from the pavement edge, define a TLOF, or the limits of a FATO. Lights should be flush mounted if located on a paved surface. On other surfaces, lights should be as low as practical--preferably not more than 8 inches (20 cm) high. The typical 100 x 100 foot (30 x 30 m) TLOF requires 16 lights (5 lights per side) spaced approximately 30 feet (9 m) apart.

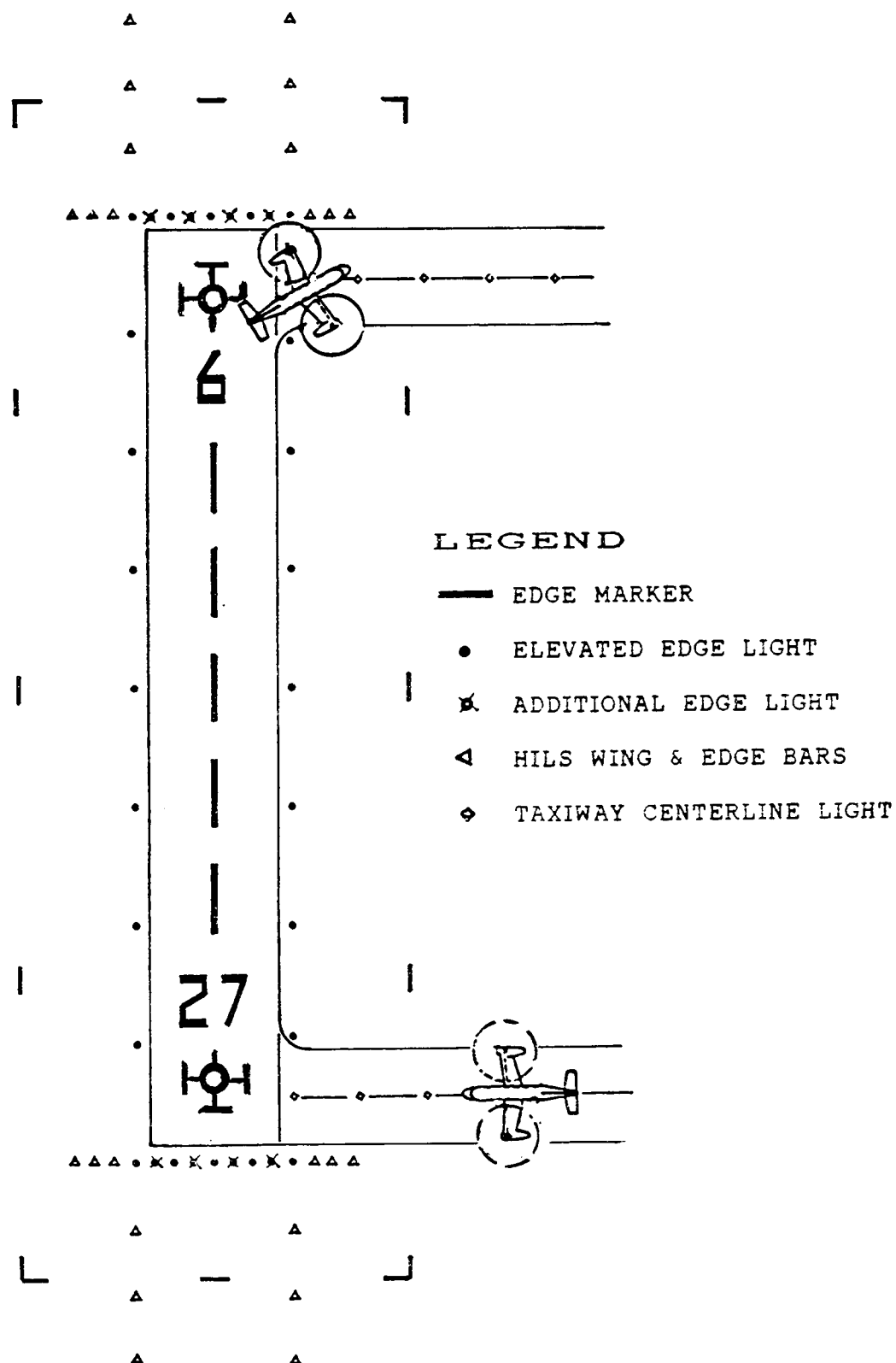
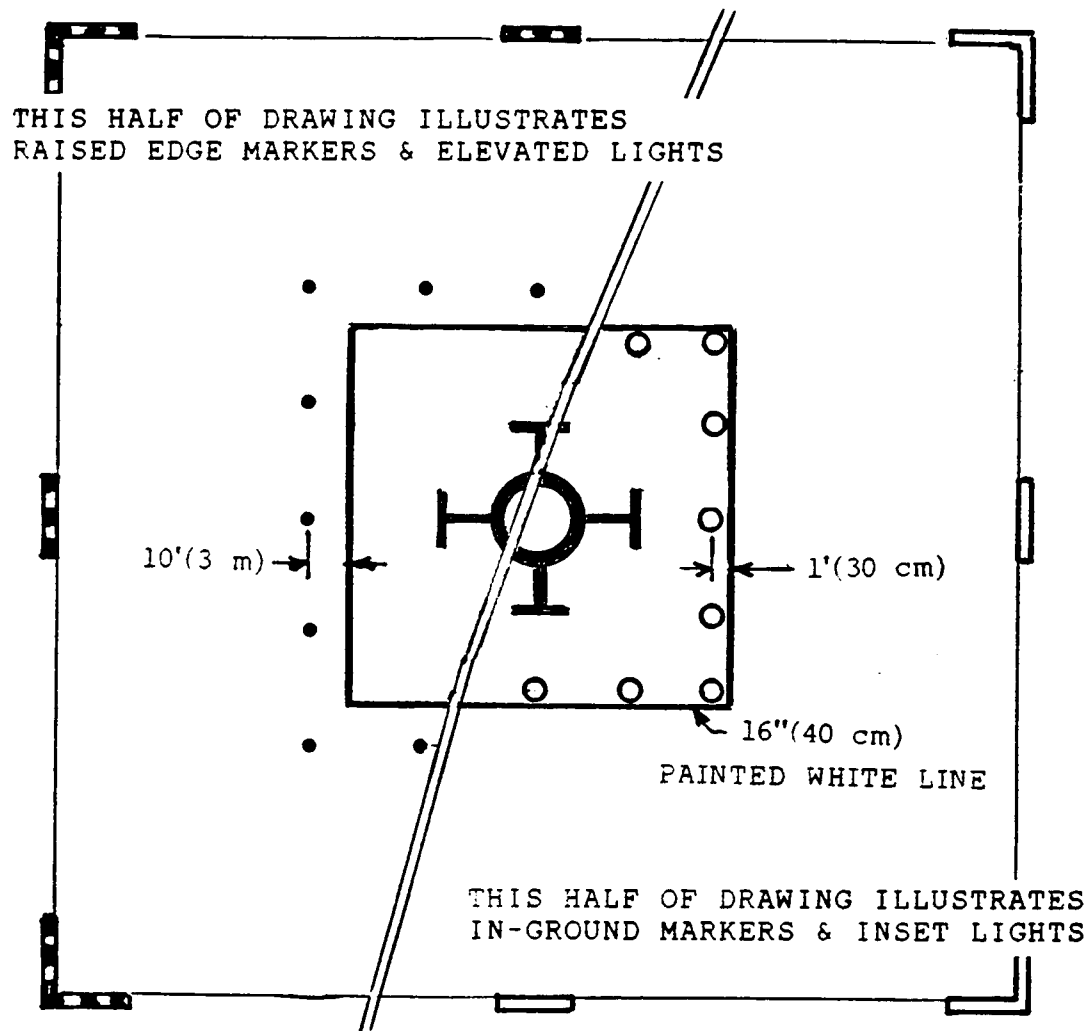

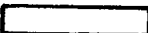


Figure 4-1. Typical vertiport marking and lighting



LEGEND

-  RAISED EDGE MARKER
-  IN-GROUND EDGE MARKER
- ELEVATED EDGE LIGHT
- INSET EDGE LIGHT

Symbol Size Exaggerated for Clarity

Figure 4-2. Typical vertistop marking and lighting

c. Taxiways. L-861 blue taxiway lights, not more than 8 inches (20 cm) high, define taxiway edges. The lights are located 10 feet (3 m) out from the edge of the full strength pavement. Alternatively, inset L-852 green bidirectional lights may be used to mark the centerline of a paved taxiway, including a taxiway located on an apron or ramp. Where centerline lights are installed, blue retroreflective markers may be used to delineate the edges of the full strength taxiway pavement. Lights and/or retroreflective markers should be spaced approximately 50 feet (15 m) apart.

d. Hover Taxiways. The edges of the hover taxiways are defined with L-861 blue taxiway lights spaced not more than 50 feet (15 m) apart.

e. Apron or Ramp. Aprons or ramps may be illuminated with floodlights located so that the mounting poles are not hazardous to aircraft operations. Floodlights must also be shielded to prevent unwanted glare in the eyes of pilots while approaching to land, while departing, or while maneuvering the aircraft on the apron or ramp.

f. Vertiport Beacon. A lighted vertiport should have an identification beacon flashing white-green-yellow pulses of light. The beacon should be located on or immediately adjacent to the vertiport. It must be placed so that it will not penetrate an approach, departure, or transitional surface nor have the beam interfere with pilot or controller vision (see AC 150/5345-12, Specification for Airport and Heliport Beacons).

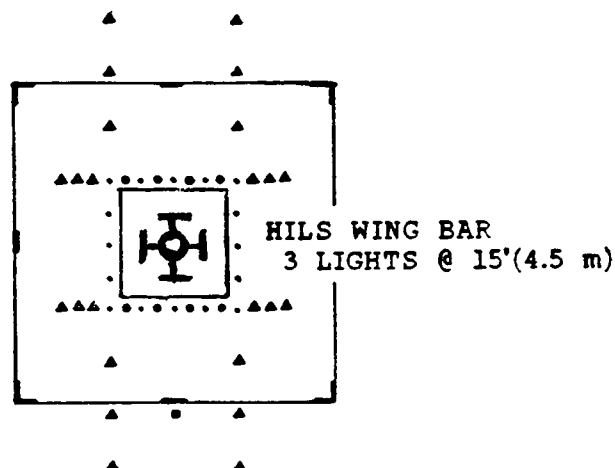
g. Parking Positions. Yellow bidirectional inset lights located at 10 foot (3 m) intervals may be used to delineate parking position guidance lines.

h. Enhanced Lighting Systems. The basic FATO and/or TLOF lighting installation must be enhanced in order for the vertiport to have a precision instrument approach procedure. This enhanced system includes high intensity lights (HILS) and an approach lighting system (HALS).

1) The HILS, illustrated in figure 4-3, consists of PAR 56 lights which extend the TLOF edge lights. The system extends both the right and left edge lights as "edge bars" and the front and rear edge lights as "wing bars."

2) The HALS, illustrated in figure 4-3, consists of PAR 56 lights and has a length of 1,000 feet (300 m).

HILS EDGE BAR 3 LIGHTS @ 50'(15 m)



HALS SYSTEM 10 BARS @ 100'(30 m)

LEGEND

- ELEVATED EDGE
- ADDITIONAL EDGE
- ▲ HILS FIXTURES
- HALS FIXTURES

Figure 4-3. HILS/HALS lighting systems

43. MICROWAVE LANDING SYSTEM (MLS). The MLS is the only practical navigational system currently available for a precision instrument approach to a vertiport. It consists of an azimuth (AZ) antenna, an elevation (EL) antenna, and precision distance measuring equipment (PDME).

a. Antenna Siting. The AZ and EL antennas are normally sited within the areas illustrated in figure 4-4. The PDME antenna is usually located with the AZ antenna. Proponents should consult with an FAA regional office for guidance on siting MLS antennas and monitors.

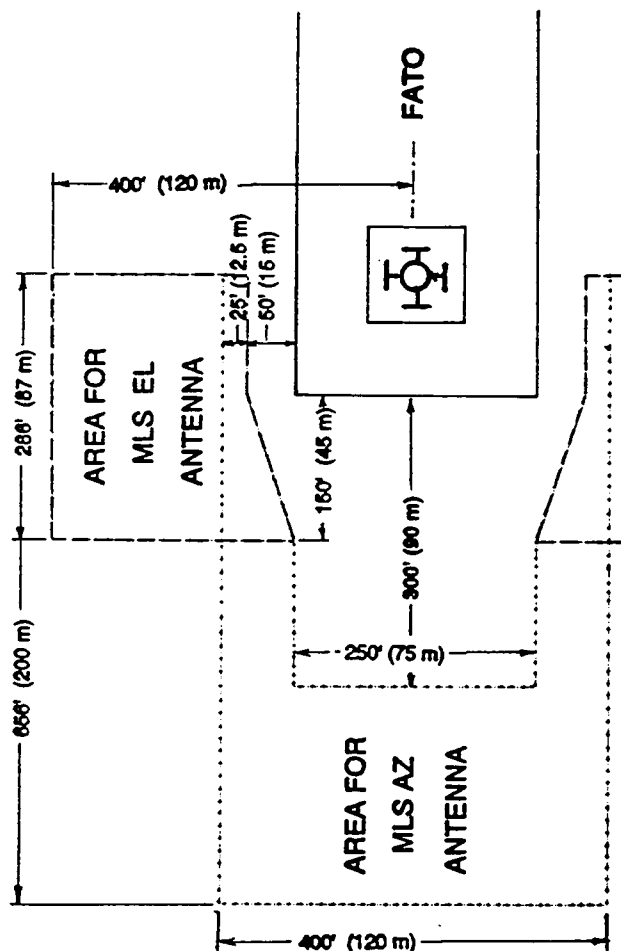


Figure 4-4. A MLS installation

b. MLS Critical Areas. Signal reflections off vehicles in the MLS critical areas can adversely affect the MLS signal. The MLS critical area must be clear of aircraft, fuel trucks, etc., whenever an aircraft is executing an IFR approach. Figure 4-5 illustrates typical MLS critical areas.

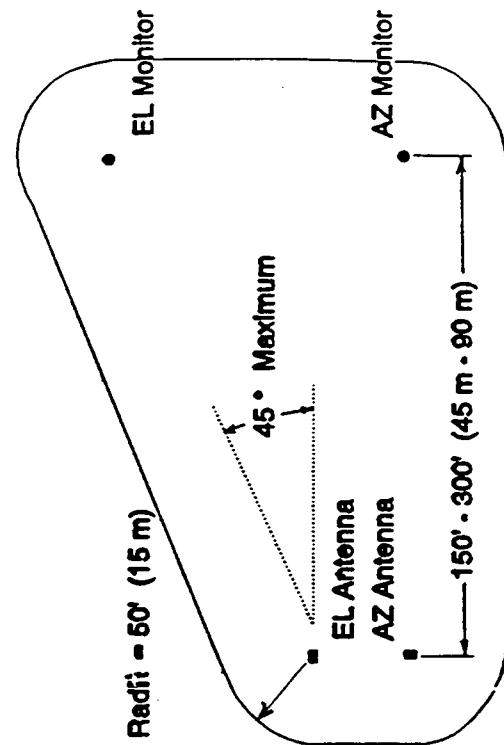


Figure 4-5. MLS critical area/antennas side-by-side

44. VISUAL GLIDE SLOPE INDICATOR (VGSI). VGSI's include the Visual Approach Slope Indicator (VASI), the Precision Approach Path Indicator (PAPI), or the Pulse Light Approach Slope Indicator (PLASI). AC 150/5345-28, Precision Approach Path Indicator, provides guidance on siting and aiming VGSI's.

a. A VGSI is recommended at all vertiports anticipating night operations.

b. A VGSI is required at vertiports with a nonprecision or precision instrument approach procedure.

45. WIND INDICATOR. A wind indicator/wind cone is required. The indicator must be visible to pilots of aircraft approaching to land as well as to pilots taxiing into position for takeoff. It should be positioned so that it provides an accurate indication of the wind conditions in the vicinity of the TLOF but should not penetrate an approach, departure, or transitional surface. Indicators must be lighted for night operations. It may be desirable to install wind indicators at several locations on a vertiport when the wind flow variations in different parts of the vertiport are operationally significant.

46. AUTOMATIC WEATHER OBSERVATION SYSTEMS (AWOS). An AWOS may be required at a vertiport to obtain lower operational minima. Guidance on AWOS installations is found in AC 150/5220-16, Automated Weather Observing Systems (AWOS) for Non-Federal Applications.

47. RUNWAY VISUAL RANGE (RVR). Visibility information is required for low visibility operations. The RVR installation provides a measurement of horizontal visibility, i.e., how far ahead the pilot of an aircraft should be able to see a high intensity vertiport edge/boundary light.

48-49. RESERVED.

CHAPTER 5. VERTIPORT LANDSIDE DESIGN

50. GENERAL. Vertiport landside features such as: passenger services (terminal and parking), hangars, employee parking, fuel storage, etc., vary from site to site. Ground space required for these features is in addition to the ground space required for airside activities. At elevated vertiports, some of these facilities and services may be located on floors one or more levels below the level of the airside surface. Vertistop landside requirements may consist of a passenger waiting area and a modest parking area. Landside facilities should be functional, attractive, and capable of orderly expansion as future needs develop. AC 150/5360-9, Planning and Design of Airport Terminal Facilities at Non-Hub Locations has guidance on terminal design.

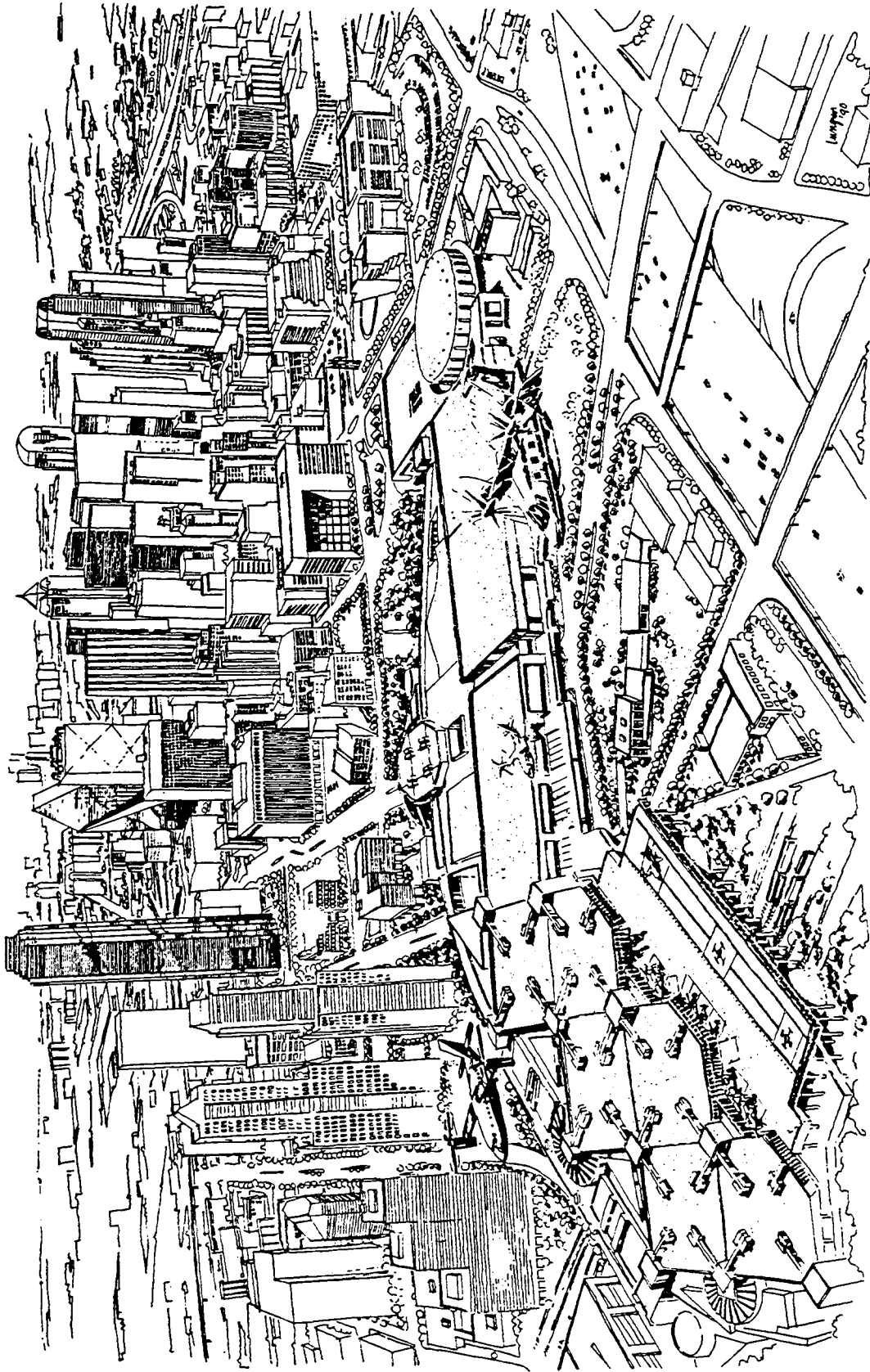
51. PASSENGER SERVICES. The type and extent of services provided to/for passengers dictates the space requirements. Airline operators will need space for administrative purposes in addition to space for passenger ticketing, waiting, and baggage makeup and retrieval. To the extent practical, permit passenger boardings to be carried out through enclosed passageways.

52. HANGARS. Normally, hangars for aircraft storage and/or maintenance would be provided at locations other than a space constrained city-center vertiport. At unconstrained facilities, locate hangars so that they will not penetrate any existing or future approach, departure, or transitional surface. Hangar sites should not compromise plans for terminal expansion or improved passenger services.

53. PARKING. Parking is required for passengers, employees, and other tenants. Employee and/or long-term passenger parking needs should not preempt space best used for short-term parking. Vehicle congestion might be minimized by locating the vertiport close to public mass transit.

54. FUEL STORAGE. Fuel storage sites and facilities must conform with all applicable local codes and ordinances on the subject. AC 150/5230-5, Aircraft Fuel Storage, Handling, and Dispensing on Airports, contains guidance on fuel handling and storage

55-59. RESERVED.



PROPOSED DALLAS, TEXAS CONVENTION CENTER VERTIPORT

CHAPTER 6. TILTROTOR FACILITIES AT AIRPORTS

60. GENERAL. Capacity demand or operational constraints because of a significant number of tiltrotor and/or rotorcraft operations at an airport will justify development of separate landing and takeoff facilities for their exclusive use. When tiltrotor and/or rotorcraft operations do not justify separate facilities, an analysis should be conducted to ensure that the airport's runway(s) and terminal or apron area configuration and the proposed location of tiltrotor and rotorcraft operating areas will allow tiltrotor and rotorcraft to operate safely.

a. Tiltrotor Operations. The facilities developed exclusively for tiltrotor operations should conform to the standards and recommendations found in chapters 2, 3, and 4 of this AC.

b. Rotorcraft Operations. The facilities developed exclusively for rotorcraft operations should conform to the standards and recommendations found in AC 150/5390-2, Heliport Design.

61. FLIGHT OPERATIONS. Approach paths and traffic patterns for the airport's fixed-wing aircraft are fixed by the configuration of the runways. Because tiltrotor and rotorcraft do not need runways, their approach paths may converge, diverge, or parallel the paths used by fixed-wing airplanes.

a. Independent Flight Paths. The approach paths for tiltrotor and rotorcraft instrument operations must take into account and be compatible with the approach paths used for fixed-wing operations.

b. Dependent or Common Flight Paths. Until sufficient demand exists or is forecast, and in the absence of capacity constraints, existing runways and navigational aids will accommodate tiltrotor and rotorcraft operations.

c. Coordination Required. The approach path(s) identified for tiltrotor and rotorcraft use should be developed as a coordinated effort involving the FAA, airport management, and aircraft operators. If new flight paths are expected to overlie previously unaffected residential areas, persons representing those adjacent residential areas should be included in the coordination process.

62. RUNWAY-TLOF SEPARATION. The potential impact of downwash generated by tiltrotors and rotorcraft on parked and taxiing light aircraft must be factored into the design and location of the TLOF.

a. Visual Operations. The recommended minimum separation between the center of the TLOF and the centerline of a runway for strictly visual operations is 700 feet (210 m).

b. Instrument Operations. The minimum TLOF to runway separation for independent nonprecision or precision instrument operations must be developed in consultation with the appropriate FAA offices.

c. FATOs/TLOFs on Aprons or Ramps. Tiltrotor and rotorcraft visual operations may be accommodated on a corner of an apron or ramp provided this area is within the manoeuvring area and the unobstructed approach surfaces described in chapter 3 are available.

d. Rotorwash Considerations. Preliminary data indicates that the rotorwash generated by a tiltrotor or large rotorcraft can affect objects less than 160 feet (49 m) away from the liftoff or touchdown point and protection should be provided for unsecured objects less than 500 feet (150 m) from the liftoff or touchdown point. Additional information on rotorwash can be found in the FAA report "Evaluation of Rotorwash Characteristics for Tiltrotor and Tiltwing Aircraft in Hovering Flight," DOT/FAA/RD-90/16.

63. GROUND OPERATIONS. Taxiways and/or hover taxi routes between TLOFs and service facilities or the passenger terminal must be compatible with other airport operations and air traffic control procedures. TLOF sites should be selected to minimize crossings of runways and taxiways used by fixed-wing aircraft.

a. Airport Traffic Control. Air traffic controllers control aircraft and ground vehicle traffic on the movement area of the airport. The airport movement area encompasses the runways, the TLOF, and the taxiway system, including apron edge taxiways. The aircraft operator is responsible for movement of the aircraft from the limit of the taxiway system to the parking or gate positions.

b. Line of Sight. If the airport has an airport traffic control tower, the TLOFs, runways, taxiways, and/or hover taxi access routes to the terminal/hangar area must be visible to air traffic controllers in the tower.

c. Apron/Ramp Parking Positions. Tiltrotor parking positions should be located on heat resistant pavements and provide clearance from buildings or passenger service equipment in accordance with the object clearance requirements of paragraph 16.

64. FUELING AREAS. A hydrant system or central fueling location in a designated area large enough to accommodate the largest tiltrotor or rotorcraft forecasted to operate at the airport is recommended. Fuel hoses should be long enough to avoid the need for aircraft to taxi close to obstacles. If refueling trucks are used, the tiltrotor and/or rotorcraft facilities should be designed to minimize the need for fuel trucks to operate on the FATO or TLOF.

65. PASSENGER TRANSFERS. Tiltrotor operations at airports will generate intra- and inter-line transfers of passengers and baggage. Tiltrotor and rotorcraft airside access should be designed so that interlining passengers are screened at their origination point and, with their carry-on baggage, will not have to be rescreened on entering the airport terminal's secured area.

66 to 69. RESERVED

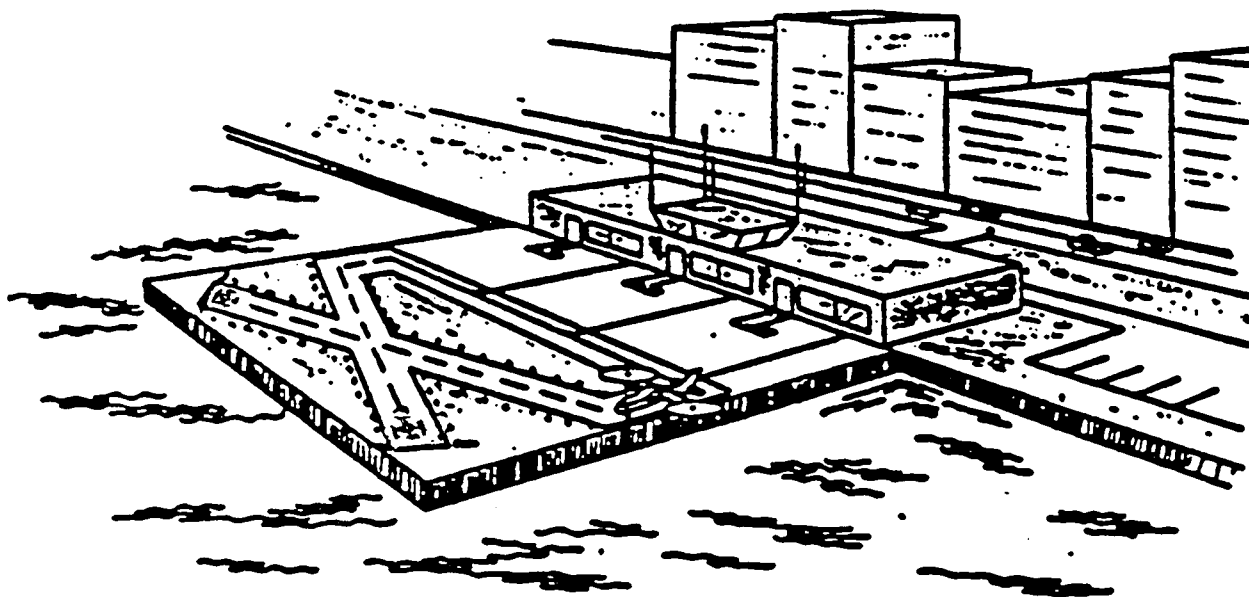
CHAPTER 7. EXAMPLES APPLYING VERTIPORT DESIGN

70. GENERAL. This chapter contains illustrations of several concepts that apply the design standards and recommendations of this AC to the planning of a vertiport or a vertistop. It is not intended that these illustrations limit a vertiport proponent's ingenuity in designing a facility to meet the requirements or limitations of a specific site.

71. COMMERCIAL SERVICE VERTIPOINTS. Figures 7-1, 7-2, and 7-3 illustrate three different concepts of how a large vertiport intended to accommodate commercial passenger or cargo services might appear. Each concept assumes a need for multiple gate positions.

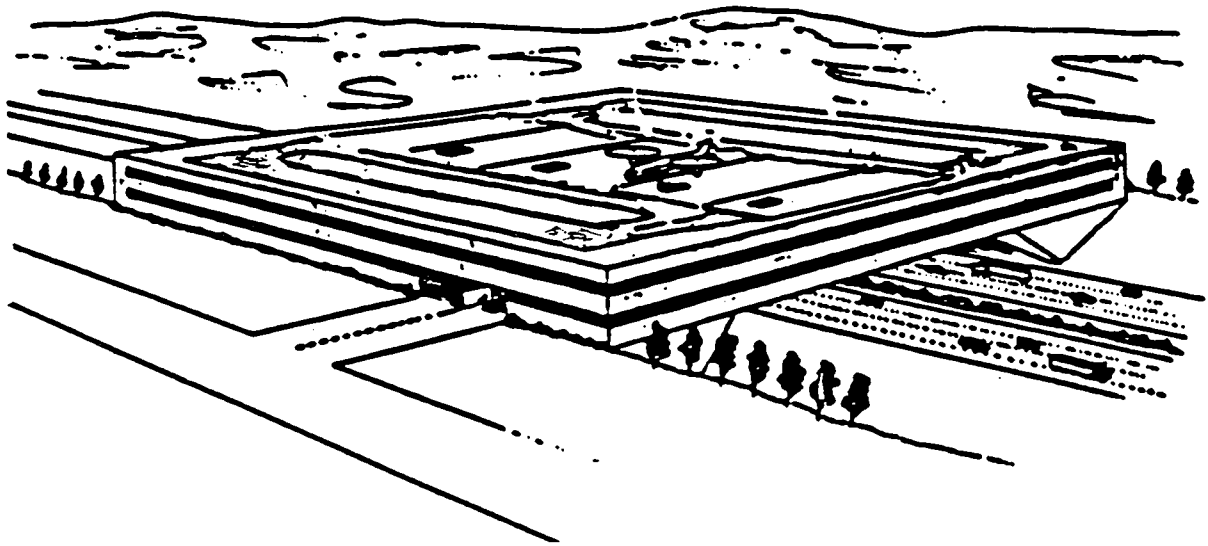
72. A "SMALL" VERTIPORT OR VERTISTOP. Figure 7-4 illustrates a concept of a ground level vertiport or vertistop capable of accommodating airline type services. The facility is designed to serve a maximum of one tiltrotor aircraft at a time.

73. AN ELEVATED PRIVATE-USE VERTIPORT. Figure 7-5 illustrates an elevated vertiport intended for the exclusive use of the owner. The facility dimensions can be proportioned according to the size of the tiltrotor aircraft being used. The limited size of the facility would restrict operations to a visual environment. The indicated weight and size limitations are not necessary since operations are to be conducted only with permission of the owner.



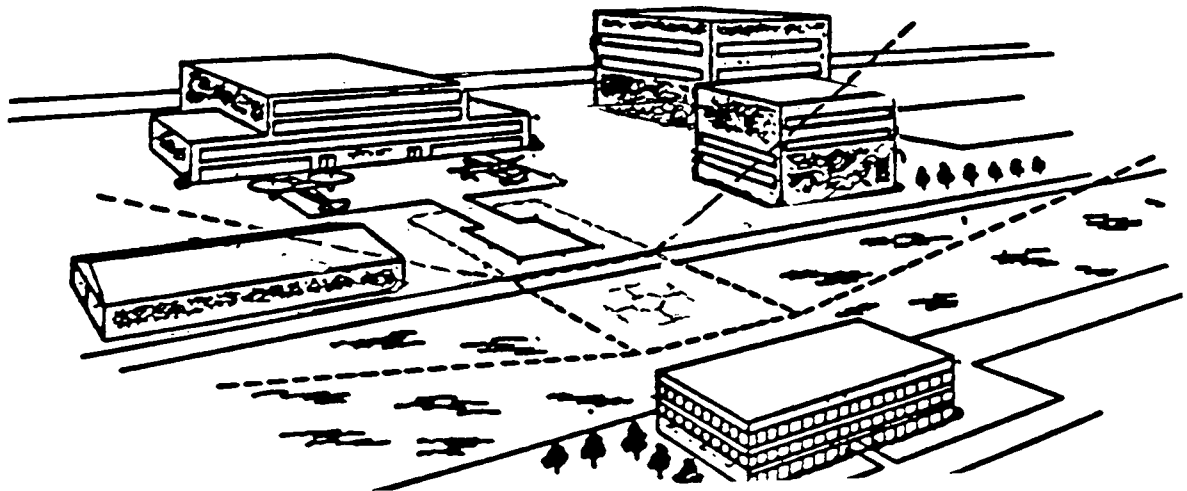
In this concept, a commercial service vertiport is located on a large pier structure extending out into the river/lake. Two elongated FATO and TLOFs cross in a shallow "X". Approaches are always made toward the shoreline. All departures are made on a heading away from the shoreline.

Figure 7-1. A vertiport on a pier



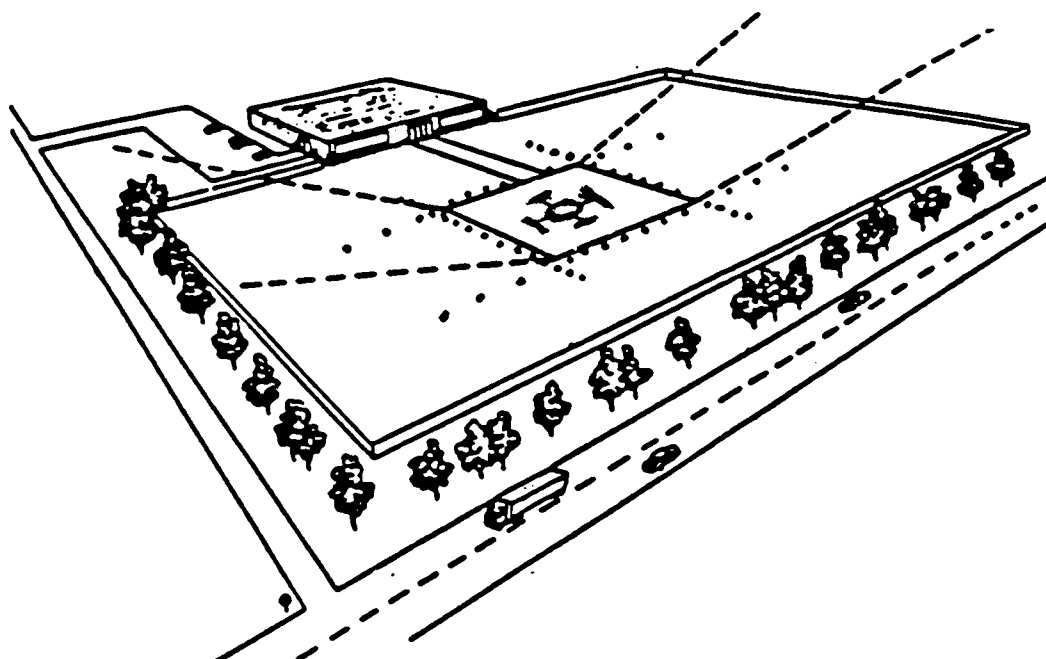
In this concept, a facility capable of accommodating 4 tiltrotor aircraft is located on a parking structure spanning a freeway. The dimensions of the structure permit a modestly elongated FATO and TLOF to be developed paralleling the long dimensions of the building. Passenger ticketing, parking, etc., is provided for immediately below the flight operations level. Additional parking is available for the general public on lower levels of the building. Passenger access to the aircraft is accomplished via an enclosed disappearing escalator which lowers to be flush with the apron surface when not in use.

Figure 7-2. A vertiport spanning a freeway



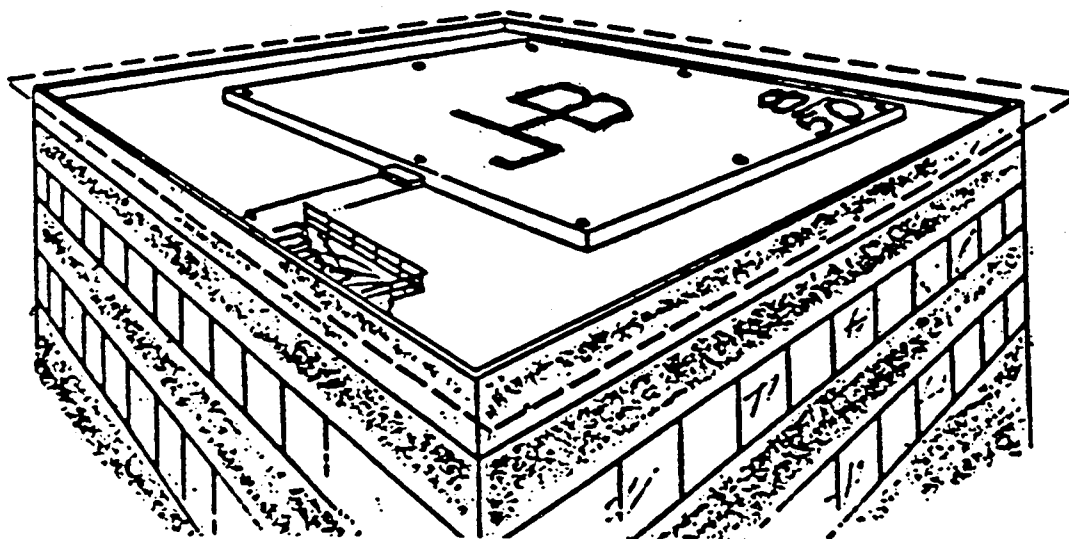
In this concept, the FATO overlies the river allowing the approach surface to be located in the uncluttered airspace over the river. The TLOF is situated on the river bank and has the recommended 75-foot (22.5 m) clearances to adjacent buildings. A paved taxiway leads to a 3 gate terminal located a modest distance in from the river's edge.

Figure 7-3. A riverfront vertiport



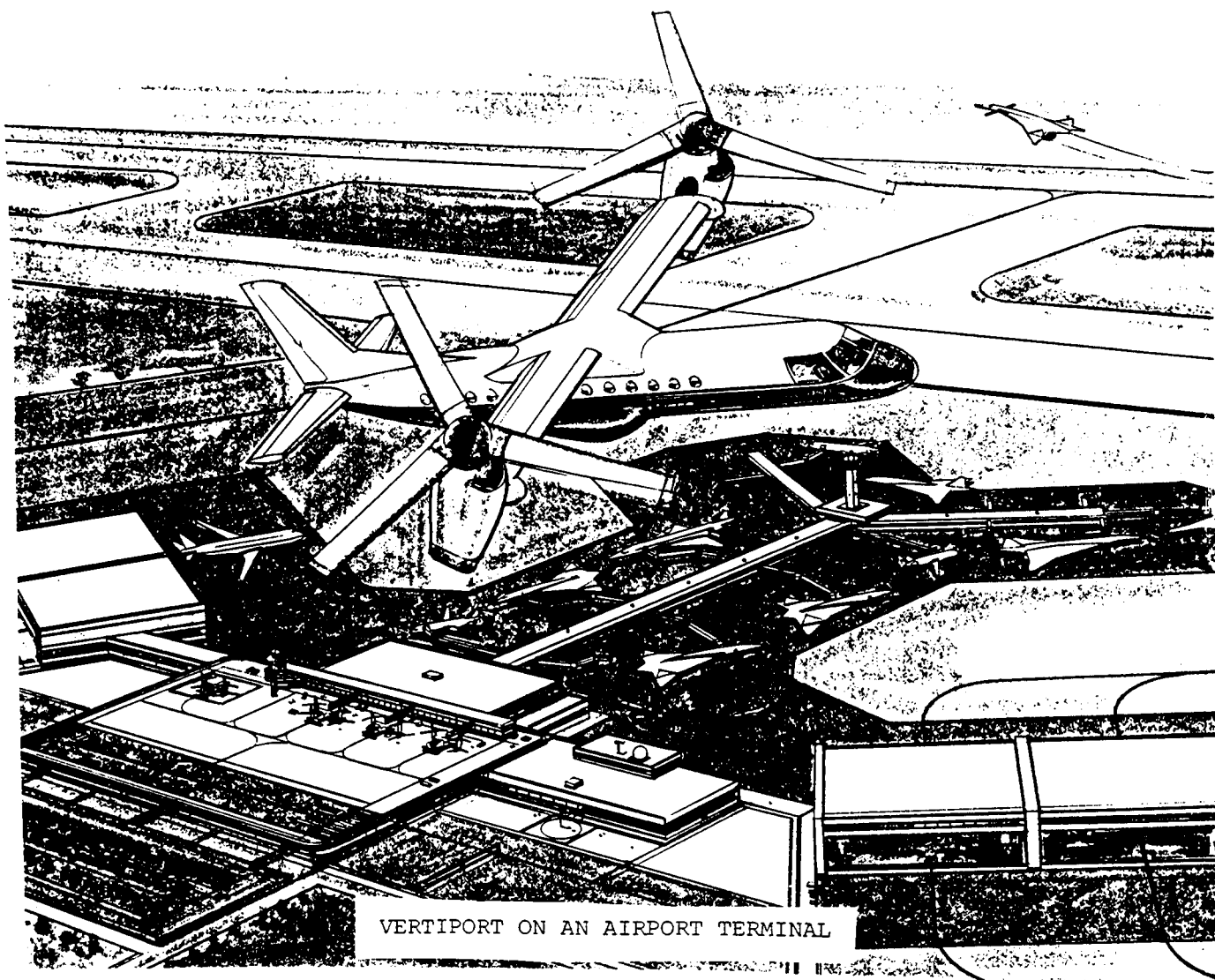
This concept illustrates a commercial vertistop accommodating minimal activity, i.e., not more than 1 tiltrotor aircraft at a time. Terminal and parking facilities are sized to meet current demands for service. Additional land is provided should there be a need to expand at a later date.

Figure 7-4. A low activity vertistop



This concept illustrates a private-use vertiport located on a rooftop intended for the exclusive use of the owner. Therefore, the FATO and raised TLOF are sized according to the size of the tiltrotor aircraft using the facility. As a private-use facility, it is permissible to have portions of the FATO lie in the clear airspace beyond the buildings edge. The raised TLOF platform is marked with the corporate symbol and shows the facility was designed to accommodate an 8,000 pound aircraft with a 50-foot rotor span.

Figure 7-5. A rooftop private-use vertiport



APPENDIX 1

NOTE: ALL DIMENSIONS ARE APPROXIMATE

MODEL	WEIGHT POUNDS	SPAN TIP-TIP FEET	ROTOR DIAMETER FEET	OVERALL LENGTH FEET	HEIGHT FEET	LANDING GEAR		NUMBER PASSENGERS
						TREAD FEET	WHEELBASE FEET	
V-2000*	4,500	29	4 F.D.	32	10	7	14	6
TW-68**	16,500	41	17	39	13	9	15	11-16
CTR-800	15,750	58	26	41	15	8	15	8
EUROTOR	18,000	76	33	52	20	13	28	19
CTR-1900	22,800	65	28	47	17	13	20	19
EUROTOR	36,000	86	36	65	21	13	28	30
CTR-22A/B	45,120	85	38	57	18	15	22	31
CTR-22C	46,230	85	38	69	21	11	30	39
CTR-22D	49,260	86	38	72	23	11	30	52
CTR-7500	79,820	109	46	84	28	17	28	75

* Fan-in-wing F.D. Fan Diameter

** Tilt-wing



V-2000



TW-68



CTR-800



EUROTOR



CTR-1900



CTR-22A/B



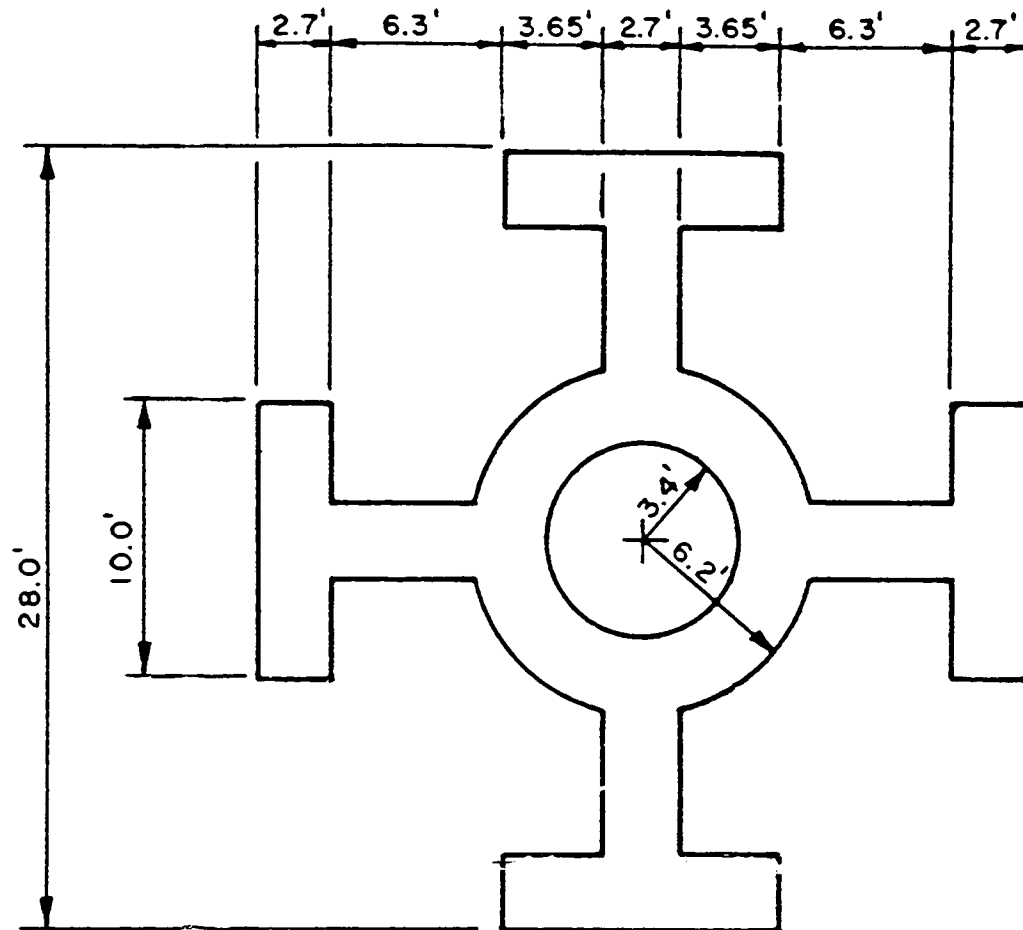
CTR-22C



CTR-7500

Tiltrotor aircraft data

APPENDIX 2



*U.S. GOVERNMENT PRINTING OFFICE: 1991--517-000/46037

Vertiport marking

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of Transportation

**Federal Aviation
Administration**

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